PUBLIC WORKS

CITY COUNTY STATE

JUNE, 1931

VOL. 62 No. 6

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JUNE, 1931

With Our Authors

Photo by Blank & Stoller, Inc.

Charles E. Trowbridge, Chief Sanitary Engineer of the American Water Works and Electric Company, was born at Agra, Kansas.

After preliminary education, he attended the University of Illinois, graduating in the class of 1916. Upon graduation he entered the employ of the Middle West Utilities Company, taking charge of the filtration plant at New Albany, Indiana, one of that Company's water works properties. After about a year in this position he entered the employ of the American Water Works and Electric Company at its East St. Louis and Interurban Water Company as chief chemist.

In 1918, Mr. Trowbridge enlisted in the army and went overseas as a lieutenant in the Sanitary Corps, seeing front line service. With cessation of hostilities, Mr. Trowbridge returned to the American Water Works and Electric Company and has since been in charge of its purification and sanitary engineering department.

GEORGE K. MACK, who contributed the excellent article on page 23, describing the methods of surface treatment used in Chowan County, North Carolina, has been highway engineer of that county since 1925. Previous to that time he spent two and a half years as mining engineer in West Virginia; two years on paving engineering and inspection work in Richmond, Va., and with the North Carolina State Highway Commission; following this he was on structure surveys with the commission.

(Ed. Note: Chowan County is a delightful section of North Carolina; this editor has many delightful remembrances of Edenton, where the good old North Carolina cooking still exists, or did a few years ago. And if the roads are as good as Mr. Mack's pictures indicate, it ought to be easy to get out to the quail sections; and the ducks aren't far away either.)

"Field Notes"

Pittsburgh Jenny Cleans Traffic Signs

Traffic signs to be effective should be instantly readable, and to be this they must be clean. As they become covered with dust, soot and other matters settling on them from the air or elsewhere, they should be washed occasionally. In Pittsburgh, Pa., the Bureau of Traffic Planning, Lewis W. McIntyre, chief engineer, uses a "high pressure jenny" for cleaning and brightening traffic signs. These ma-

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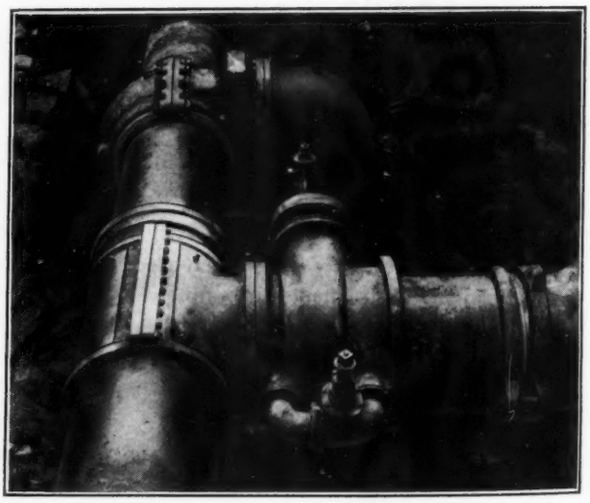
chines have been used for years in industrial plants for cleaning greasy floors and windows.

After a careful study of the requirements of the traffic bureau in Pittsburgh in its work of cleaning signs, painted curbs, pavement markings and the like, a plan was devised for mounting such a "jenny" on a truck so that it could be transported to various parts of the city. It shoots hot water vapor under a pressure of 150 pounds onto the sign or object to be cleaned. When the job is finished the sign is bright and clear. A good deal of labor, as well as paint, is saved by this method of cleaning, in the opinion of Pittsburgh traffic men.

So far as it is known, Pittsburgh is the first city to use the "jenny" in its traffic work.

Making a Large Branch Connection Under Pressure

An unusual surgical operation was made on a 30-inch main recently at Ogdensburg, N. Y. A 30-inch horizontal valve was inserted in the main, and a few feet from it, a 24-inch connection for a branch was made to the same main. At no time during the making of the insertion or of the branch connection was the pressure on the main lessened one iota; and, although the work, particularly of making the insertion, required a considerable time to complete, still no one in the city was aware that these important waterworks changes were being made. The work was done by means of machines rented from the A. P. Smith Manufacturing Company.



Large branch connection and valve insertion at Ogdensburg

It is only recently that insertions as large as this have been made in this manner. The company named is equipped to make valve insertions of any size up to 30-inch and branch connections up to 42-inch. For the larger insertions and connections the common practice is to rent the machines, with an expert to supervise the operation.

Advantages of Lighting Highways

Studies of highway lighting made on a road near Schenectady, N. Y., described in PUBLIC WORKS for August, 1930, were referred to by Dudley M. Diggs, member of the Rural Hazards Committee, National

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Safety Council, in an address before the Delaware Safety Council, and the statement made that definite conclusion on certain points had been reached.

"Satisfactory results in the lighting of our experimental mile of highway were obtained by using two fundamental principles: first, the principle of silhouette lighting; and second, an intensity that would make feasible running with lowered or depressed headlight beams."

The advantages of a well-lighted highway, he summarized as follows:

"1. It would minimize headlight glare, making it possible to drive with lowered or depressed beams; reveal the presence of pedestrians or other objects in the vehicle's path; illuminate the sides of the road, and in other ways greatly increase the factor of safety on the highway.

"2. It would show any holes and other obstacles in the roadway, which are now at least partially obscured and only noticed as shadows on irregular road surfaces.

"3. It would give additional comfort in night driving, which also makes for quicker physical reaction.

"4. Highway lighting would spread traffic more equally over the twenty-four hours, not confining it, as now, largely to the day.

"Proper highway lighting is the solution of some of the most vexing problems confronting those who are working for the safety of the highways. Its advantages may be had at a relatively small cost. In the case of the experimental mile of roadway referred to, the whole annual cost including installation, maintenance and current was less than 3 per cent of the initial cost of the road."

Car Operating Costs in North Dakota

The cost of operating cars owned by the Department of State Highways of North Dakota was 6.07 cents per mile in 1930. This cost has been subdivided into three general headings: operation, upkeep and overhead.

The average cost per mile for each item entering into these subdivisions is shown in the table:

Labor—garages	.0091	
Parts	.0072	
Miscellaneous and accessories	.0052	
Storage	.0022	
Total upkeep—1930		.0237
Gas	.0146	
Oil	.0026	
Tires	.0029	
Total operating—1930		.0201
Salaries (administrative)	.0050	
Miscellaneous (includes license int. at 6 per cent, chief mech. traveling expense)	.0006	
Insurance (fire and theft)	.0002	
Depreciation—1930	.0111	
Total overhead—1930		.0169
Grand total		.0607

Commenting upon this, the Department in its monthly publication says:

"Professor Agg of Iowa State College, in his study of car operating costs, found that the average cost of operating light sixes and light fours on intermediate type roads, and figuring 11,000 miles per year as the distance traveled, was 6.02 cents per mile. As some of our cars are used on winter maintenance and earth grade construction and thus operate under severe traffic conditions, we should expect higher operating costs than average. The close agreement with Professor Agg's figures is very gratifying."

9 Distinct Advantages of this MUELLER Pipe Jointer . . .

ADVANTAGES OF MUELLER PIPE JOINTERS

1 Saves Time

To apply the MUELLER Pipe jointer it is simply necessary to place it around the spigot with the bevelled side towards the bell, tighten the clamp just snugly, drive the jointer against the face of the bell, and tighten the clamp firmly. A small piece of clay backing for the pouring space is all that is necessary then to have a joint perfectly prepared for pouring.

2 Surer and Safer to Use

The MUELLER Pipe jointer makes a leak-proof joint against the spigot and the bell by compression and therefore *does not require any clay* except the small piece for the pouring gate. This insures full, solid poured joints and eliminates the old bugaboo of breaking-out and mis-runs.

3 Insures Perfect Joints

The bevelled side of the MUELLER Pipe jointer produces an evenly cast ring of lead with just the proper allowance for caulking. This predetermined uniformity insures that the joint will be caulked evenly and the same amount all around.

The controlled size and shape of the pouring gate permits it to be removed by caulking under it, thus eliminating the danger encountered when a gate is cut off with a chisel.

4 Durable

The body of MUELLER Pipe jointers is made of special heat-resistant material which has sufficient resiliency to make secure joints against the bell and spigot.

5 Strong and Permanent Shape

A sheet brass band entirely surrounds the jointing material and is riveted securely to it. This gives the jointer the necessary strength and prevents it from ever stretching, shrinking, or changing shape.

6 Sturdy Clamp Ears

The clamp ears are made of high-grade steel forgings riveted securely to the brass strip and jointing material. They will not break or bend.

7 Rugged Clamp

The clamp is made of highest-grade malleable iron and designed with a high factor of safety.

8 May be used with lead substitutes

MUELLER Pipe jointers will work satisfactorily with lead substitute jointing material but the smaller sizes must be ordered especially for this purpose to have sufficient width of pouring space.

9 One-Piece Jointer

There are no loose pieces on the MUELLER Pipe jointer to get lost or misplaced.

MUELLER CO., (Established 1857), Decatur, Illinois: *Branches*: New York, Dallas, Atlanta, San Francisco, Los Angeles, Chicago; *Canadian Factory*: MUELLER, Limited, Sarnia.

MUELLER

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Unit Construction Costs

TOWNS OF MARLBORO & EAST HAMPTON, CONN.

Grading & Drainage Only on 10650 Ft.

Bids Received March 2, 1931

Items	*Unit*	*Quant.*	*a Price*	*b Price*	*c Price*
No. Working Days at		$40.00	60	90	100
Clearing and Grubbing	L.S.				
Earth Excavation	C.Y.	28,807	.60	.65	.60
Rock Excavation	C.Y.	56,014	.60	.65	.60
Unclasified Excavation	C.Y.	880	3.00	1.00	1.25
Borrow	C.Y.	12,120	.50	.40	.40
Shape Slopes & Shoulders	L.F.	10,650	.02	.10	.06
Gravel Fill Subbase	C.Y.	13,623	.50	.60	.65
Class "A" Concrete	C.Y.	433	15.00	11.00	15.00
Class "B" Concrete	C.Y.	299	13.00	11.00	15.00
Deformed Steel Bars	Lbs.	94,716	.05	.04	.045
Catch Basin	Each	1	75.00	50.00	100.00
Install 18″ R.C.P.	L.F.	572	.75	1.25	1.00
Install 24″ R.C.P.	L.F.	44	1.00	1.50	1.00
Install 30″ R.C.P.	L.F.	48	1.50	2.00	3.00
Install 36″ R.C.P.	L.F.	108	2.00	3.00	4.00
Waterproof Painting	S.Y.	935	.30	.20	.90
Vit. Tile Underdrains	L.F.	3,900	1.00	1.40	1.25
Vit. Tile Outlets	L.F.	300	.50	.50	.50
Wire Fence	L.F.	11,190	.17	.18	.22
Wire Rope Railing	L.F.	8,100	.50	.47	.60
Ditch Excavation	C.Y.	2,000	1.00	1.00	.75
Single Guide Posts	Each	100	1.50	1.00	1.00
			$98,403.70	$102,010.29	$103,157.07

(a) Edgewood Concrete Co.; (b) Thompson Constr. Co.; (c) Angelo Tomaso.

State of New Hampshire, Highway Department

Project No. 198-E

Bids opened 4/24/31 for Highway Improvement in Derry-Windham-Salem

ITEMS		Quantity	A.	B.
Earth Excavation	cy	30,644	.35	.20
Fine Grading	sy	153,982	.02	.05
Borrow (Earth)	cy	31,395	.40	.40
Ledge Excavation	cy	5,625	2.50	3.50
Trench Ex. (Earth)	cy	572	.525	.30
Trench Ex. (Earth)	cy	30	.70	.40
Gravel Base Course	cy	12,825	.65	.75
1 crse. Re. Con. Pave.	sy	76,944	1.57	1.75
Class C Concrete	cy	21	17.00	14.00
Class D Concrete	cy	199	14.00	12.00
Reinforcing Steel	lb	3,763	.05	.05
Laying 12″ C.M. Pipe	lf	407	.25	.10
Laying 18″ R.C. Pipe	lf	1,230	.40	.30
Laying 24″ R.C. Pipe	lf	484	.75	.30
Laying 30″ R.C. Pipe	lf	91	1.50	.50
Laying 36″ R.C. Pipe	lf	55	3.00	1.50
Catch Basins	ea	1	100.00	50.00
Wood Guard Rail	lf	1,196	.40	.50
Wire Cable Rail W.P.	lf	15,925	.43	.45
Anchorages Cable G.R.	ea	112	10.00	12.00
Clear and Grubbing	acre	4.5	50.00	50.00
Removing Trees		75	8.00	8.00
Working Days			100.00	100.00
Maint. of Traffic		55,500	.03	.01
TOTAL			$193,010.72	$210,619.05

A—A. D. Bridge's Sons, Inc., Hazardville, Conn.
B—Arborio Road Const. Co., Inc., 525 Main St., Hartford, Conn.
C—P. J. Holland, Lawrence, Mass. $211,818.39
D—Portland Contracting Co., Portland, Me. 216,779.81
E—R. G. Watkins & Son, Inc., & Central Const. Co., Amesbury, Mass. 227,378.61
F—B. Perini & Sons, Inc., Ashland, Mass. 227,676.12
G—State Construction Co., Inc., 508 Main St., Saugus, Mass 227,681.29
H—Angelo Susi & Co., 68 Cedrus Ave., Roslindale, Mass. 229,316.45
I—G. Bonazzoli & Sons, Hudson, Mass. 230,558.82
J—R. E. Bull, 151 Harrison Ave., Fitchburg, Mass. 233,682.48
K—Carlo Bianchi & Co., Inc., Framingham, Mass. 237,723.01
L—Joseph McCormick, East Providence, R. I. 236,765.68
M—D. W. Overocker, Brattleboro, Vermont 250,740.50
N—John A. Gaffey & Sons, 19 James St., Medford, Mass. 271,971.90

Paving

CLAY CENTER, KANSAS

Date of Contract—June 17, 1930

2,591 sq. yds. concrete paving; 6″ thick, plain; 6.8 bags cement per cu. yd. of concrete; 3″ to 5″ slump; cost per sq. yd.	$ 1.97
1,090 sq. yds. brick paving; 2½″ brick on a 5″ concrete base; same specifications as above; asphalt filler; cost per sq. yd.	2.60
1,777.7 cu. yds. grading at average depth of 1″ in soil; cost per cu. yd.	.60
995 lin. ft. 6″ curb and 3′ gutter; 1-4 base 5½″ thick; ½″ finish of 1-2 mortar.	
Cost of labor; per day of 8 hours	3 20
Cost of sand delivered; per yard	1.50
Cost of cement per 100 lbs., delivered	.70

Total contract price: $10,745.03.
Contractors: Reed & Wheelock.
Information furnished by Harry L. Stevens, city engineer.
(Kansas Municipalities.)

PUBLIC WORKS

An Engineering and Construction Journal

City County State

VOL. 62 JUNE, 1931 NO. 6

TABLE OF CONTENTS FOR JUNE, 1931

Notes From the Cocoanut Grove:

Editor, Public Works:

Dear Sir—My transit was in pretty good order when your May issue arrived yesterday so I took it out in the coco grove and solved your problem. Sorry that I did not see it in the *Saturday Evening Post* two or three years ago. Haven't had so much fun since I first trisected an angle with ruler and compass some years ago.

But say! How in the ——— did those five guys do so much counting in one night without running into one another? 18,746 cocos is some bunch to be counted so many times in one night.

We don't have any long nights like that except in the Arctic and Antarctic regions, and cocos don't grow on islands in those locations.

The poor monk must be dead with only five, and the rest must have died with indigestion.

Next!

Yours very truly,
WALTER S. WHEELER,
City Engineer, Dover, N. H.

(Ed. Note: We thank Mr. Wheeler for his enjoyable letter and correct solution. There are, of course, an infinite number of solutions, and we believe that there is one considerably smaller than that given above. He is absolutely correct, though, in saying the monk gets the very short end of the deal, and that there was some heavy counting during the night.)

Another Solution

And while we are solving problems, please turn to page 17 of the February issue. WHAT IS THE ENGINEER'S NAME? If any of our problem loving readers have found out, they have been too modest to give us the solution. Here it is, though.

From 5, we learn that the man living nearest the engineer is an official; and from 6 that that official's name is not the same as the conductor's name (since salaries are not usually calculated to thirds of a cent). From 4, we learn that the man living nearest him is not Mr. Jones; and from 1, 2, 3, and 4 (draw a diagram, if necessary) that it is not Mr. Robinson. Therefore it must be Mr. Smith. Therefore, from 6, the conductor's name is not Smith. From 7, the fireman's name is not Smith. Therefore, the engineer's name is Smith.—Q. E. D.

R. S. V. P.

The annual dinner of the Order of the Boar will be held at (or near) Carlisle Barracks, Pa., Monday evening, July 13. This is an annual get-together of a group of men interested in sanitary engineering. While actual membership in the Order is restricted to those men who have attended the course in Military Sanitation at Carlisle Barracks, a cordial invitation (on a strictly Dutch basis) is extended to all who are interested in sanitation. Please make your reservation early to M. J. Blew, Northeast Works, Philadelphia, Pa.

J. T. MORRIS, *President*
W. A. HARDENBERGH, *Vice-Pres. & Asso. Editor*
CROXTON MORRIS, *Ass't Manager*

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PUBLIC WORKS

CITY COUNTY STATE

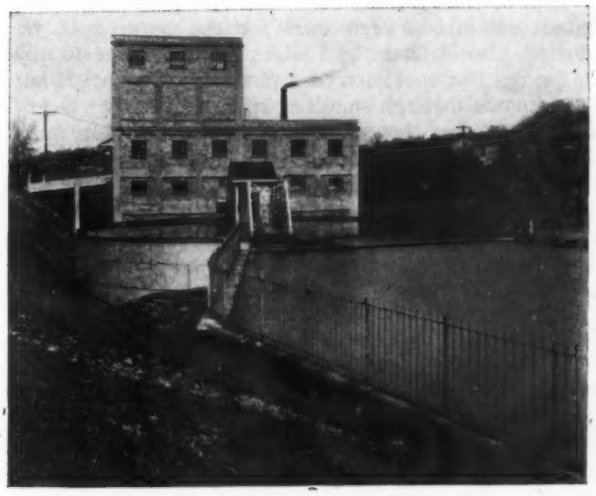
AN ENGINEERING AND CONSTRUCTION MONTHLY

Vol. 62 June, 1931 No. 6

Activated Carbon Removes Tastes and Odors From Water

By Charles E. Trowbridge

Chief Sanitary Engineer, American Water Works and Electric Company, Inc.



Softening plant at Hays Mine Station

SEVERAL years ago, when the South Pittsburgh Water Company, (a subsidiary of the American Water Works and Electric Company) was having trouble with pollution of its source of water supply (the Monongahela river) by phenol wastes, it was necessary to install a system of regular sample collection from points up the river to determine and prove the source of pollution, which was found to be from by-product coke plants. When the companies operating the by-product plants had been convinced that their wastes could cause objectionable tastes and odors in the water supplies drawn from the river at points downstream, they agreed to dispose of their wastes so as to prevent further pollution of the river. It was still necessary, however, for the water company to continue the regular collection of samples from the river to guard against the recurrence of a sudden pollution of the stream by an accidental spill from the by-product plants.

For several years now the South Pittsburgh Water Company has protected its source of water supply by continuing to collect daily samples from eight or ten points and test them for the presence of phenol wastes. During this time occasions have occurred when serious pollutions of the river have been prevented by calling the matter to the attention of the by-product coke plants so they could cooperate by correcting the spill before it became serious.

This problem of stream pollution by wastes from by-product plants has received a great deal of attention by the water works profession in an effort to discover a method of treating the water supplies so as to remove the tar-acid substances causing the taste and odors. These experiments have only recently developed a partially successful treatment; it is the general opinion of health authorities and water works operators that the practical solution of the problem lies in the elimination of the trouble at its source. The successful operation of such a plan depends upon the regular sampling of the streams to detect the first trace of pollution, similar to the system established by the South Pittsburgh Water Company. There remains, however, always the chance of an accidental spill of wastes into streams with the resulting effect upon the public water supplies to worry the water works operator. For this reason the search has continued for some means of preventing objectionable taste and odor in the public water supplies should these wastes reach the stream by accident.

Recent experiments have shown that activated carbon has the property of adsorbing volatile matter, and that the powdered form of carbon will remove these substances when they are dissolved in water, even in extremely high dilutions. Laboratory tests indicated that the powdered form of activated carbon, when thoroughly mixed with water, will adsorb phenol wastes present in water in such small quantities as are likely to be found in sources of water supply.

When an accidental spill occurred during the latter part of October in a by-product coke plant on the Monongahela river, quantities of phenol wastes entered the stream sufficient to cause a taste and odor in the water. The regular sampling of the stream gave prompt warning of what had happened; and there was sufficient time before the polluted water could reach the intake to arrange a plant size experiment on the use of activated carbon for taste and odor removal. A carload of powdered carbon was obtained by fast

freight and it arrived on time. The treatment was promptly started and consisted of adding the powdered carbon to the raw water in the proper amount. After a thorough mixing of the carbon with the water, the carbon was completely removed by the regular coagulation and filtration process.

The treatment proved to be a success. The samples of the river water showed that phenols were present at the water works intake for several days, while the effluent of the filter plant remained free from taste and odor as a result of the activated carbon treatment process.

This is probably the first time that pulverized activated carbon has been used for the purpose of removing phenol tastes and odors from a water supply in the regular operation of a purification plant. It has been known through smaller experiments that some of the activated carbons had the property of adsorbing taste- and odor-producing substances in water, but the cost of these carbons has prevented their use. The cost of the powdered activated carbon treatment, as used in this case, is very high also. For this reason, the treatment as used cannot at this time be considered a practical one for continuous use.

This successful plant-size experiment at South Pittsburgh is very important, however, for the results are very promising for the development of a means to protect a water supply against objectionable tastes and odors caused by an accidental spill of phenol wastes into the stream.

It can also be used to prevent tastes due to low water. The extended drought of 1930 greatly reduced the quantity of water available in the sources of many public water supplies. As a result, in some cases unusual difficulties have been experienced in producing a satisfactory effluent water by regular purification methods, because of the prevalence of disagreeable taste and odor substances in the raw water. These substances in the stream and impounded waters come mainly from vegetation, but in some instances industrial and other wastes reach the streams also, to add to the difficulties of water purification. The tastes and odors commonly present in streams during low flows may be described as "woody," "musty," "bitter," or "disagreeable."

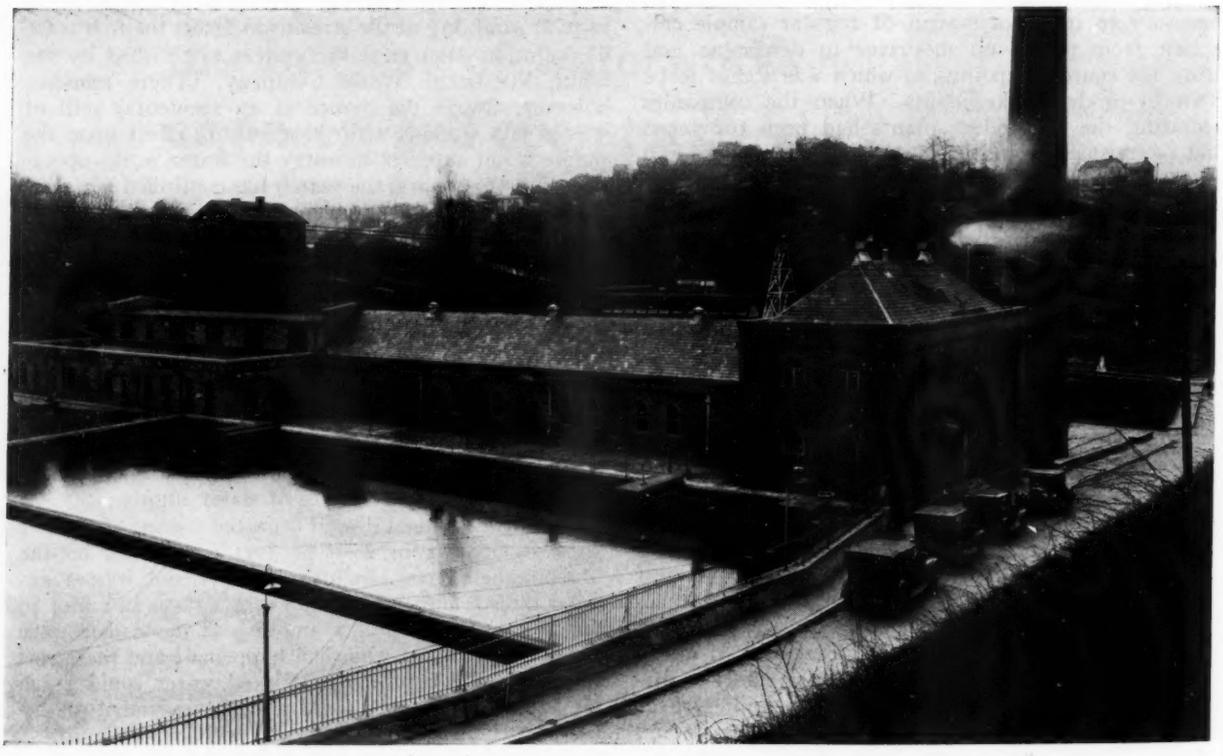
Experiments in the use of Nuchar, an activated carbon, for the removal of tastes and odors in the purification of water have been carried on at six of the plants of the American Water Works and Electric Company during recent months. These experiments have been on a plant scale with the entire water supply treated, and the results have been very gratifying. The grade of Nuchar carbon used is highly pulverized, with a large percentage of the carbon passing a 200-mesh sieve.

In most of the experiments so far, the carbon has been applied to the raw water. The purpose has been to obtain as complete diffusion of the carbon particles through the water as possible. In some cases, the treatment has been applied so as to obtain a mixing of the carbon with the water before the coagulant has been added. The treatment has varied from 30 to 140 pounds per million gallons, or from .2 to 1 grain per gallon, depending upon the intensity of the substances to be removed.

The action of the carbon particles in removing the taste and odor substances from the water depends upon the property of activated carbon for adsorbing more or less volatile matter.

In the most recent experiments at The City of New Castle Water Company, the carbon has been added to the settled water applied to the filters, on the theory

(Continued on page 60)



Hays Mine Pumping Station and Filtration Plant

A Guide to Assist Designing Engineers in Preparing Reports on Water Supply Systems and Purification Plants

FULL reports are generally required by state boards of health when engineers present plans for water supplies and purification plants for approval. The following headings, which are taken from Special Bulletin No. 211 of the Bureau of Engineering and Inspection of the North Carolina State Board of Health, H. E. Miller, Director, will serve as an excellent guide as to what is necessary, and will also provide a valuable check in designing the plant. Plans and specifications should show all this information in more or less detail, and these will be supplemented by the engineer's report with full explanatory description under each heading as outlined.

a. Population studies: Character of community to be served, estimated growth by five year periods until available capacity is exceeded, or at least forty years hence.

b. Consumption Statistics: Per capita and total as per (a) use of water by large industries or uses other than domestic, with location of such use and estimates of amount.

c. Describe general nature of development of supply, e.g., surface run off, lakes, springs, wells, or combination of these. Locate each descriptively by reference to map. Enumerate principal works, e.g., dams, intakes, reservoirs, coagulating basins, pumping stations, filtration plants, each on general plan. Gravity or pumped. Submit all data bearing on the sanitary quality of the water, and if possible, laboratory analyses—similar data on chemical and physical characteristics. Possible sources of pollutions and possible objections to its use.

*d. Surface Waters: Give perimeter of entire watershed tributary to source of supply, showing calculated area. Give approximate course of stream from which supply is taken and all branch feeders to stream. The approximate lines of cultivated, wooded, and old field areas within watershed area. The approximate location and sanitary condition of all farm houses, and other dwellings and premises, with number of persons occupying each. Should there be either running or dry branches or ditches contiguous to such dwelling houses or to stables, cattle pens, or pig pens, note whether or not the outhouses, stables, cattle pens, etc., drain directly into such branches or ditches or how far distant they are located. Where factories or other industrial establishments or timber cutting operations are located on the watershed, give number of operators regularly employed and method of sewage disposal regularly practiced. If villages or groups of dwellings are located on watershed, give data as to sewage and drainage disposal regularly employed, the approximate location of all public roads, churches, burial grounds, camp meeting and picnic grounds, parks, within one-half mile of stream used as source of supply. Where water is to be taken from a stream more than 15 miles from its source, this information is only to be given to a point 15 miles above the proposed intake.

e. Lakes and Large Reservoirs: Similar data to (d) on main feeders. Size, capacity, shore pollution, boating. Intake arrangement and location.

f. Wells: Number, location relative to towns or other populated area contiguous, size and depth, formations passed through; date drilled, casings, protection against surface pollution; is well to be bored, jetted, or driven. If a proposed well, give all geological data, log of wells in vicinity, logs of borings and analyses on these obtainable. When wells are located near streams that carry town drainage, state tributary population to such drainage, length of stream and high water line of stream relative to well heads.

g. Springs: Location. Seasonal variations in output. Describe development works and protection against pollution, using map for reference.

h. Raw Water Reservoirs: Location, elevation, size, capacity and area at various depths. Inlet and outlet, type and relation to each other as regards producing effective sedimentation.

i. Regulation of Water to Plant: Strainer and intake devices. Difference in elevation between water level at intake and that in coagulation basin or reservoir. Length and size of pipe line. Raw water pumping units, number of units, size; designed for what capacity, against what head and at what speed; nature of pumps, kind of power, emergency provisions. Provision for measuring water delivered to plant. Aeration.

j. Mixing Chamber:
1. Location and arrangement, covers, baffles, etc.
2. Forebay—arrangement, by-pass, dimensions.
3. Dimensions.
4. Capacity.
5. Retention.
6. Velocity.
7. Allowable head (total and minimum amount per baffle).
8. Outlet devices.
9. Drainage.

k. Coagulating Basins:
1. Location and arrangement—cover.
2. Distribution of flow:
   Inlet devices.
   Outlet devices.
   Overflow provisions.
   Elevations, maximum, minimum, and average.
3. Dimensions.
4. Capacity.
5. Rentention time.
6. Velocity.
7. Drainage.

1. Coagulant Devices:
1. Location and arrangement.
2. Type and control of chemical feed.

* In the case of water supplies involving filtration the engineer may treat this item in a general way and the map with detailed information may be furnished by the town upon completion of the works.

3. Solution tanks—Number and dimensions, capacity, maximum and working level.
4. Points of application.
5. Appurtenances:
   Dissolving devices.
   Mixing and agitating devices.
   Size and kind of piping.
   Orifices.
   Drains to solution tanks.

m. Filter Units:
1. Type, material, number of units.
2. Areas and capacities for each unit and total for plant.
3. Dimensions of unit (length, width and depth).
4. Number wash troughs, material and shape:
   Dimensions, distance above sand (top trough to top sand).
   Percent sand area covered. Maximum travel suspended particles.
5. Filtering Material:
   Sand—kind, depth, effective size and uniformity coefficient.
   Gravel—kind, depth, number of layers and depth and size of each layer.
6. Filter Bottom:
   Type and material.
   Manifold, size and cross section.
   Laterals—number, spacing, site and length.
   Openings for strainers—number, spacing, size, position.
   Strainers—type, position, number, size holes with number per strainer, total cross sectional area of holes. Figure ratios of sand area to strainer opening area, strainer opening to total cross sectional area of strainer neck openings, strainer neck openings to total cross sectional lateral openings and total lateral openings to cross sectional area of manifold (i.e., ratios for these upon which design is based).
7. Operation Features:
   Depth water on sand—normal, maximum, and minimum.
   Type and rate of wash designed for.
8. Appurtenances:
   Loss of head gauges—type and location.
   Rate controllers—type and location.
   Rate of flow gauges—type and location.

n. Wash Water Facilities:
1. Head available at filter manifold.
2. Pumps—number, capacity, type, and operating head.
3. Tank—location, material, dimensions and elevations, capacity (total number washes), head available to top of wash trough (minimum), provision for overflow, cover and drains.
4. Waste water disposal—if well used give dimensions, capacity, number of washes, method of operating, location, elevation, etc.

o. Pipe Gallery:
1. Arrangement and location and dimensions.
2. Sizes and velocities in pipes and conduits:
   Raw.
   Main influent.
   Branch influent.
   Main effluent.
   Branch effluent.
   Main wash water.
   Branch wash water.
   Main sewer.
   Branch sewer.
   Rewash.
3. Type of valve control.
4. Drainage.

p. Clear Well:
1. Location and arrangement.
2. Dimensions.
3. Capacity.
4. Retention time.
5. Cover, manhole, vents, distribution and circulation, location of high service suction, float for water level indication.

q. Storage on System:
   Reservoirs and standpipes, with capacity, dimensions, elevations, material, etc.
   Provisions for meeting fire fighting requirements.

r. Laboratory—equipment and space.

s. Pumps for high pressure service. Number, types, capacities, static and working heads designed for. Kind of power.

t. Sterilization or Disinfection:
1. Chemical employed.
2. Type apparatus.
3. Point of application.
4. Control of amount applied, scales, flow meters, automatic devices, hand control, etc.

u. Weirs, meters, or other measuring devices.

v. By-pass arrangements which may result in delivery of inferior grade of water. Emergency intakes.

w. Instructions for operating any portion of plant properly required of designer, especially as relates to treatment and purification works. What is period of retainer for engineering supervision of operation? Submit estimate of operating costs with particular reference to amount and kind of attendance. Describe type of man to be entrusted with operation of purification works. Is plant designed for continuous full 24 hour operation, or what portion of the day?

x. Distribution System:
1. Area, extent, location and population supplied.
2. Single or dual system, interconnections with other systems. Possibility for infection from exposed valves on non-domestic supplies, if any.
3. Dead ends, necessity for, provisions for flushing and blowing out, relative size of mains and blow-offs.

Denver's Clean Streets and Alleys

Denver, Colorado, claims that it has the reputation of being "the cleanest city in America," and to maintain that reputation, says the official publication "Municipal Facts," "equipment has been purchased in order that her streets may be cleaned as efficiently and noiselessly as possible. Denver is today the only large city that cleans her alleys as well as her streets regularly. The department manufactures its own brooms and has constructed several street sprinklers and a considerable amount of street cleaning equipment—representing an immense saving."

In connection with the city's use of road oil for laying dust, "the city has purchased road oil heaters and distributors, which have more than paid for themselves."

To Feed Hogs With Kansas City Garbage

An ordinance, recently passed in Kansas City, Mo., permits the present garbage collecting contractor in that city to erect a hog feeding plant on the edge of the city for the disposal of the city's garbage; substituting hog feeding for the former feed manufacturing method of disposal, because the present feed milling company, a subcontractor for disposal, is unable to operate at a profit.

The proposed hog feeding plant in Kansas City will be 1¼ miles from the nearest residence. The garbage collecting contractor receives $7.45 a ton for collecting and disposing. He will be required to erect hog feeding platforms of concrete, surrounded with an 18-inch water tight curb. Adequate sewerage and water supply for flushing the platforms daily must be provided, and he will have to pay the salary of an inspector from the health department to remain at the plant.

Bituminous Surface Treatment at Low Cost

By George K. Mack
County Engineer, Chowan County, North Carolina

CHOWAN COUNTY, N. C., last year applied surface treatment to 6½ miles of 16-foot sand and sand-clay roads at an average cost of $774.92 per mile. The bituminous material was MexPet Surfaseal No. 2 (cut-back AC) and the binder was crushed granite, 1-inch to ¼-inch, with the dust screened out. The equipment employed included a 600-gallon pressure distributor, 1½- and 2-ton International trucks and a Fordson roller.

The procedure in constructing the surface on a sand-clay or clay-gravel base was as follows: 1. Smoth the grade with a light road machine or maintainer. 2. Reverse blade and carry loose material to the shoulder, leaving a slight berm outside of the edge of proposed treatment. This strengthens the edge and prevents bitumen from flowing into ditch. 3. Sweep all dust to the sides and apply to one side—8 feet wide approximately—½ gallon per square yard of prime road oil or tar prime material. This allows traffic to use the side not primed. After from 24 to 48 hours, seal with 1/3 to ½ gallon per square yard using Surfaseal No. 2 or equivalent, about 20 to 40 Engler viscosity cut-back asphalt. Cover this with 18 to 25 pounds of crushed stone, 1-inch to ¼-inch, and roll within 24 to 48 hours. Turn traffic over the treated side, and proceed with the treatment of the other side as above. When both sides have been covered with aggregate, a broom drag is used behind a light truck, dragging from the center to the sides, and reversing back to the center. This is done for a period of 24 to 48 hours, and prevents traffic from forming one track or a rut, and kicking the stone out to the sides. It also gives a more uniformly covered surface. It is then rolled until the aggregate is well compacted. Very little trouble has been experienced for two years with raveling on this type.

For re-treatment, or a seal surface, the old surface is broomed clean of all material, and any depressions or breaks are patched with cold patch material. One side is then treated 1/3 with 0.2 to 0.4 of the above asphaltic material or a hot tar seal material; the rate of application depends upon the porosity of the old surface. This is covered immediately with approximately 20 lbs. of chips per sq. yd., using ¾" to ¼" with dust screened out. Traffic is then allowed to travel this side while the other side is being treated in the same manner, broom dragging and rolling the entire surface as explained above for first treatments.

The above methods are used on sand-clay and clay-gravel bases. We have considerable mileage in our county composed of sand base, with no clay binder. Approximately three miles of this type has been treated by the mixed-in-place method, obtaining from 2" to 4" thickness, and carrying heavy traffic for three years with very little maintenance. The usual method of mixing in place was followed, except that through one village where there is considerable turning off of the pavement, wooden headers were used to confine the treatment. The sand treated was composed largely of fines, and will meet specifications for sheet asphalt sand. Four applications were made of approximately ½ gal. per sq. yd. each. After each

(Continued on page 60)

Applying 2/3 gal. cut-back asphalt to sand subgrade for mixed-in-place treatment. Total used 2 gallons per square yard, covered with 20 lbs. of ¾" to ¼" granite chips.

Re-treating two-year old asphalt surface treatment on sand subgrade; using ½ gal. of cut-back asphalt and 20 lbs. of granite chips. Cost $775 per mile.

Mixed in place Tarvia B prime on native sand in 1928. Resealed in August, 1930, with Mex Pet Surfaseal No. 2 and covered with 20 pounds of ¾" to ¼" granite chips, and rolled with 3½ ton roller. Roadway 15 feet wide, 2" x 4" wooden headers along sides staked every 4 feet.

The South Greensboro Sewage Treatment Plant

By C. W. Smedberg
Director of Public Works and Service, Greensboro, N. C.

The S. Greensboro Plant in Brief

Capacity of plant—3¼ m.g.d. dry weather flow; 6½ m.g.d. wet weather.

Control Chamber—Two 36″ sluice gates, to control by-passing to creek.

Coarse bar screen—Link Belt Co. mechanically cleaned. 1½″ x ¼″ bars, 1″ clear openings.

Grit Chambers (two)—Dorr type 10′ square, 18″ water depth.

Pumping Station—
Wet well—Capacity 37,000 gal.
Pumps—two 0.5 to 2.5 m.g.d. variable-speed pumps, and two 2.0 m.g.d. constant-speed; Yeomans Bros. pumps operated by Westinghouse motors.
Switch board—7 panels, Westinghouse design and construction.

Primary Sedimentation Tank—Dorr type, 70 ft. square, 11 ft. depth of water at sides.
Sludge removed to digestion tank by a 3″ Yeomans Bros. centrifugal pump.

Sludge Digestion Tank—Dorr type, 60 ft. diameter, 23 ft. deep. Concrete roof with two gas domes 3 by 5 ft.

Control House—Electrical control of digestion and sedimentation and of pH of digestion tank; Wallace & Tiernan dry feed machine.

Sludge Drying Beds—Six 52.7 ft. by 103 ft. (= 1 square foot per capita). Concrete floor; 7″ of 2″ to ¼″ broken stone and 12″ of sand. Industrial track for removing sludge.

Sprinkling Filters—Two 188.5 ft. by 199.33 ft. each. "Metro" block floor; 7 ft. of broken stone. Inspection galleries along division and end walls. Distribution system, 24″ c. i. main, 6″ and 4″ laterals. Marley type nozzle tees; ⅞″ Type C Taylor nozzles.

Secondary Sedimentation Tank—Door type 50 ft. square, 9 ft. water depth at side.

Cost—Plant $350,598 = $10.79 per capita of plant capacity.

Mechanical Equipment

Link Belt mechanically cleaned screen.

Dorr collecting and cleaning mechanism in grit chambers; electric hoist to remove screenings.

Float-actuated pump control to automatically control speed of pumps.

Switchboard control of sewage and sludge pumps, and of grit chamber, sedimentation tank, digestion tank, and bar screen mechanisms.

Dorr sludge collecting mechanism in primary and secondary sedimentation tanks and sludge digestion tank.

Gas boiler with automatic heat control.

Wallace & Tiernan dry-feed machine.

Industrial track and steel cars for removing sludge from beds.

Pacific Flush Tank Co. siphons in dosing tanks.

THE City of Greensboro, N. C., recently completed and placed into operation an interceptor sewer and a treatment plant of the separate sludge digestion, sprinkling filter type, to treat the sewage from the southern half of the city at one site, thereby eliminating three former antiquated and inadequate septic tanks and relieving aggravating conditions existing along South Buffalo creek by reason of inadequately treated sewage being discharged therein. The interceptor and treatment plant completes in part a program which ultimately will enable collection and treatment of all the city's sewage at two plants, one serving the northern half and the now completed plant, the southern half of the city.

In 1929 studies were made jointly by the engineers of the State Board of Health, the State Department of Conservation and Development, and the City Water and Sewer Department. Stream gauging stations were established on each stream, and the sources of liquid wastes, their volume, contributing pollution, and effects along the creeks were determined by numerous analyses of individual and composite textile, industrial and domestic sewage and stream samples. All wastes studied were converted to the equivalent domestic sewage load. The limited stream flow afforded, and the volume of wastes, indicated early in the study that complete treatment of wastes prior to disposal would be necessary, and that more detail studies of textile wastes, as to character and of methods of treatment, alone or combined with domestic sewage, should be made.

The sewage flow from the southern part of the city being preponderantly domesitc in character and possible of treatment by available accepted methods, the the Water and Sewer Department was authorized to proceed with the design and construction of the South Greensboro interceptor and plant; the contemplated interceptor and plant for the northern half of the city being held in abeyance pending the completion of studies of the wastes peculiar to the area.

Interceptor Sewer—The newly constructed interceptor sewer is 6,636 feet long, of 30 and 36-inch vitrified clay pipe, and lies, for its entire length, parallel to South Buffalo creek. It was designed for an ultimate population of 37,000 with a maximum per capita flow of 360 gallons. The estimated present connected population is 20,000. Pipe joints throughout are made with G-K sewer pipe jointing compound. The former septic tanks have been removed and the outfalls extended so as to discharge directly into the interceptor.

General Plant Description

The treatment plant lies approximately three-fourths mile east of the city limits. It consists of a bypass-control chamber, coarse bar screen, grit chambers, pumping station, primary and secondary sedimenta-

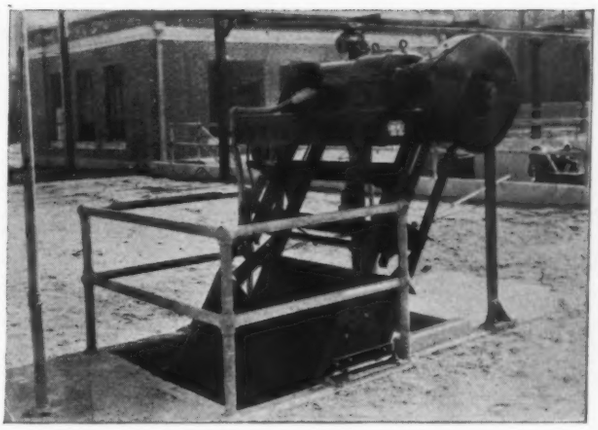
tion tanks, sludge digestion tanks, control house, twin dosing tanks, sprinkling filters and open sludge drying beds. An earth levee surrounds the plant site as a protection during flood stages on South Buffalo creek, into which the plant effluent is discharged.

The plant is designed to treat a dry-weather flow of 3¾ m.g.d. and a wet-weather flow of twice this amount, all in excess of this being bypassed to the creek without treatment. As at present constructed, the plant anticipates an ultimate contributing population of 32,500; however, the capacity may be doubled by the duplication of the existing structures.

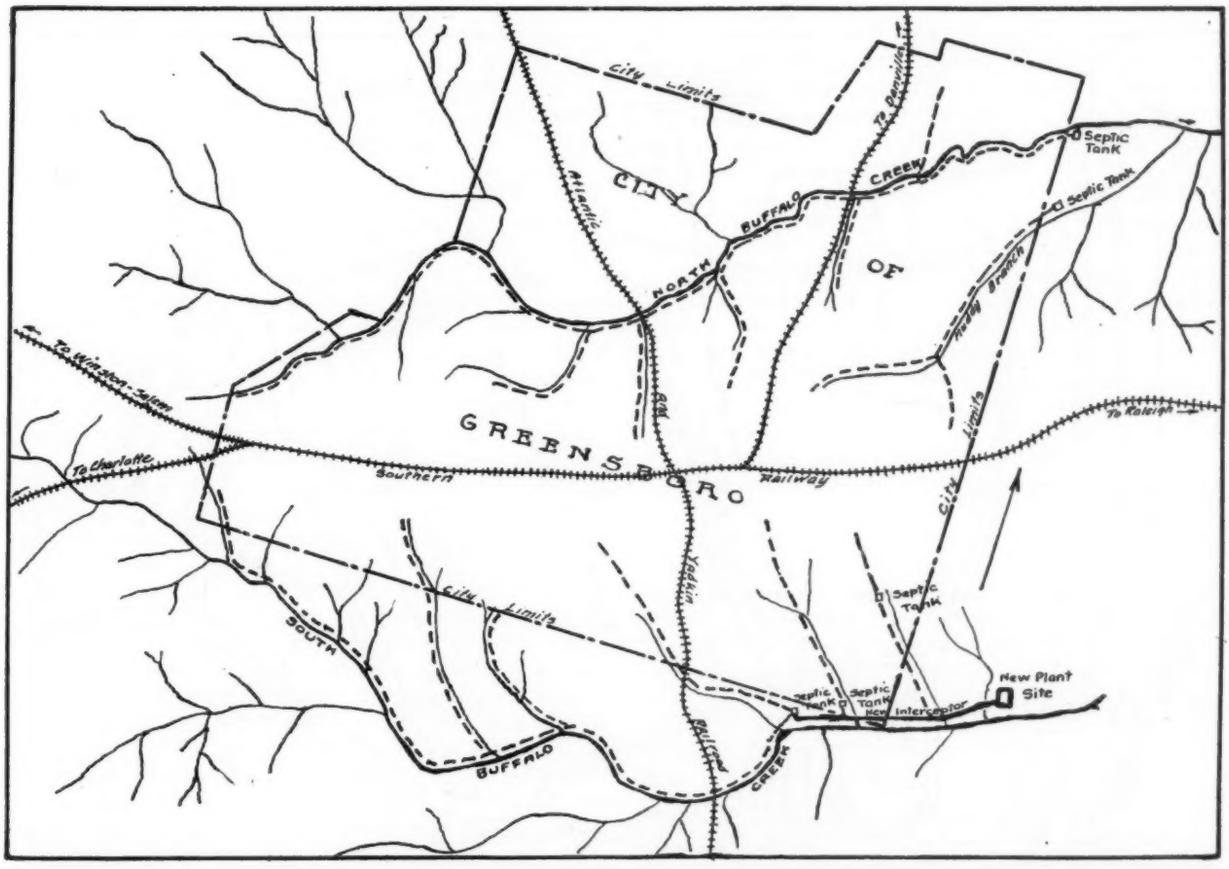
Control Chamber—The sewage enters the treatment plant at the control chamber, where all or part of the flow can be bypassed to the creek. The control chamber is a concrete structure built within the earth levee and consists essentially of an upper and lower compartment. The sewage normally flows through the upper compartment and is controlled by a 36-inch circular sluice gate. One side wall of the upper compartment is made by a 36-inch square inverted-type sluice gate, the upper edge of which serves as an adjustable weir, and enables diversion of the flow in desired amounts to the lower compartment, which is directly connected to the creek.

From the control chamber the sewage flows through a 36-inch vitrified clay pipe line approximately 500 feet long to a coarse bar screen located midway of a concrete box section 2½ feet deep, 4 feet wide and 70 feet long.

Coarse Bar Screen—The coarse bar screen chamber is formed by the vertical extension of the side walls of the box section to ground level. It contains a Link Belt Company mechanically cleaned, inclined bar screen, of ¼ x 1½ inch bars set on edge with 1 inch clear openings. A mechanically operated rake cleans the screen and deposits the screenings upon an operating platform at ground level for draining prior to disposal. The interval between rakings of the screen may be varied from 2 seconds to 33 minutes by means of a time relay. The operation of the screen is protected by safety devices, electrically operated through a control panel.



Coarse bar screen. Pumping station in background.



Map of Greensboro, showing location of creeks, interceptor sewers, old septic tanks, and new treatment plant.

Right foreground, pumping station and grit chambers. Background, coarse bar screen and sedimentation tank.

From the screen chamber, the sewage may be diverted to either or both of two grit chambers, or direct to the wet well of the pumping station. The grit chambers, wet well and pumping station are combined into a structure 37 feet by 74 feet in plan, the wet well being located between the grit chambers and the substructure of the pumping station.

Grit Chambers—The two grit chambers are of the Dorr type, each 10 feet square with a water depth of 18 inches and a rated capacity of 3½ m.g.d. They are designed to allow only the heavy grit particles to settle out, so far as possible. A collecting mechanism within the chamber moves the settled grit to its periphery, where it is collected in scoops and transported to the cleaning mechanism located along one side of the chamber, which, by a reciprocating motion, rakes the grit particles above water level, discharging them free of excessive moisture at the end of the channel. During the raking process the grit is sufficiently agitated to thoroughly remove the organic matter from the grit particles. The washed grit is deposited in

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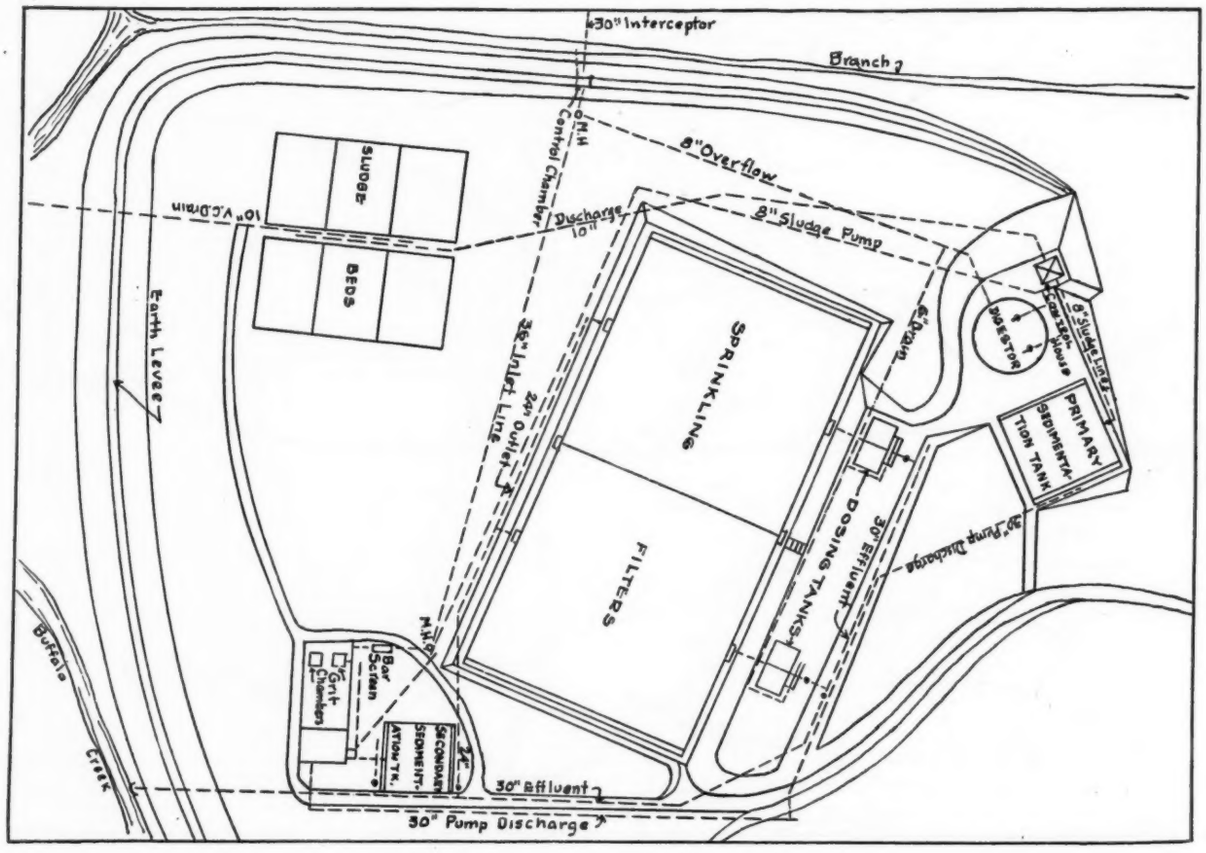


Plan of Greensboro sewage treatment plant.

At the Mercy of the Storm—Weather and the Sewage Plant

By Morris M. Cohn
Sanitary Engineer, Dept. of Public Works, Schenectady, New York

"AT THE MERCY OF THE STORM" would make an appropriate title for a melodrama thriller of the sea, staged with the raging wind howling through the rigging of a storm-tossed ship, the rain pelting down in torrents on the tilted decks and untamed lightning and thunder tearing from a sullen sky. Strange that I have chosen it for a drab story of the sewage-works.

Is it so strange? Every storm breaks over the face of the uncomplaining treatment plant, white caps break on the deep walls of the grit chamber, workers pick their way ticklishly over the cat-walks of the Imhoff tank, the ice on the filters resembles the ice floes of the northern wastes through which a whaler steers its course. When it's hot in town the plant concrete and sand surfaces absorb the heat and become blistering infernos. The cold of downtown is mildness itself compared with the arctic aspects of the snow-covered works. When the wind blows, it sweeps with fiendish glee over the unprotected plant, droning a dismal dirge around the buildings.

I'm not referring to those soft sewage treatment plants pampered by designers with enclosures. What do the operators of those installations know about the rigors of winter or the sunburn of summer? I speak with the bitterness of an operator who has had to shun society for weeks while a blistered neck recovered from the parboil of a too-benign sun. I have had to rub my ears with snow before dashing from the experience of supervising a January chore on the tanks into the comforting warmth of the office. I have learned the trick of immersing numbed fingers into warm sewage to prevent the agonies of frost-bite. I have swathed my frame in slicker and skidded out into the downpour while a surcharged siphon was placed in normal operation. It was a heavy wind storm that propelled me into the yawning depths of the Imhoff tank to take the only inspection trip to an operating tank ever reported in the technical press.

The orthodox type plant is a hardy spirit. It is set out in the middle of an open site with most of its units exposed to the whims of the elements until it gives up the ghost to live no more. The battering it gets shortens its path to the scrap heap. The staff of men who keep the process processing have the leathern faces and gnarled hands of the salty sailors of old. The inconvenience to them, however, is inconsequential compared with the effect of the weather on the efficiency of the treatment units themselves. To the operator, personally, the weather is of importance only because of its effect on his comfort. He discusses the meteorological phenomena much as he would discuss the doings of his home neighborhood. His "Warm enough for you?" is in much the same tone his wife might use in questioning about his morning coffee. He discusses the rainy spell with the exasperation he would show about the soggy condition of his breakfast toast. The temperature decides whether he must start his furnace or put on heavy socks. His wife questions him about the sharpness of the wind for the purpose of deciding whether she can put Junior out to get his air.

But at the treatment works, the superintendent assumes a different mien. He views the thermometer, consults his barometer, discusses the old saws about mackerel skies, white frosts and moon rings before he decides what to do about sludge drawing, flow reversal and grit chamber cleaning. The capable operator is weather-minded; he plans his activities with the weather vagaries.

But there are many conditions which do not lend themselves to control. Sewage treatment is, in the main, a biological process. The bacterial life upon which the operator depends cannot protect itself against the weather like the plant worker who peels off his shirt in the summer and builds himself a cocoon of a sheepskin jacket when winter comes. You simply cannot put an overcoat on a tank anaerobe or a filter aerobe and keep it functioning in cold weather.

What is the effect of the weather? Let us consider the poor Imhoff. It should prove the point. It is one of those hardy spirits of old, still braving the elements.

The Imhoff tank has two functions, but cannot feel independent of the climatic conditions in either one. It is simple to conceive the effect of the weather on sludge digestion. Winter arrives at the sewage-works and the mercury deserts the thin thermometer column and tries to crowd down into the warmth of the bulb. Slowly the temperature of the incoming raw sewage drops into the frigid forties. Deep down in the depths of the sludge digestion hopper the depositing solids have been serving as the feasting ground for active bacteria. The temperature falls gradually as the cold hand of winter immerses itself into the dank depths. The undigested solids lie in foul banks piling up steadily, steadily to the neutral zone itself.

Comes the spring and then the summer. There is an awakening of life. Solids become sludge, there is a gassing and a belching as the machinery of digestion reaches full momentum. It is an old story. Digestion depends on temperature. The designer and the operator have long ago become resigned to the fate. Provision for cold storage has been made. The operator does his share by an intensive program of sludge removal in the summer to make room for the trying winter period. The pitcher pump may tell the operator when he *ought to* draw sludge. The thermometer whispers to the bacteria and the bacteria tell the operator when he *can* draw sludge.

The operator plays a watchful waiting game. He knows his limitations in attempting to control the mysterious biochemical agencies of digestion. It is the effect of weather on the simple process of sedimentation which irks him. The rain falls in all its

wild abandon on the city and quantities of storm and ground water come raging down the trunk sewer into the tanks. Detention periods are decreased and sedimentation efficiency goes the way of the operator's good humor. Some compensation is obtained from the fact that it takes a summer rain to freshen up the surface of an Imhoff tank.

It is an ill wind that blows no good for the Imhoff tank. A breeze in the right direction keeps floating solids and grease curd piled up at one end of the tanks and makes skimming easy. The experienced tank man knows which wind quarter brings him a light day. It takes a strong breeze blowing toward the effluent end of the tanks to carry quantities of floating solids out with the effluent, clog screens and make a hollow sham of the normal hydraulics of the Imhoffs. The wind shows an indecisiveness which is often troublesome. Many flow reversals are wisely planned to conform with normal sectional wind changes. It adds to the burdens of the operator that the air movements so often are not as expected. Is it any wonder that the tank attendant braces himself against the breeze as he sways across narrow walks, while he discusses for the whole world to hear the freakish winds which cause him so much trouble?

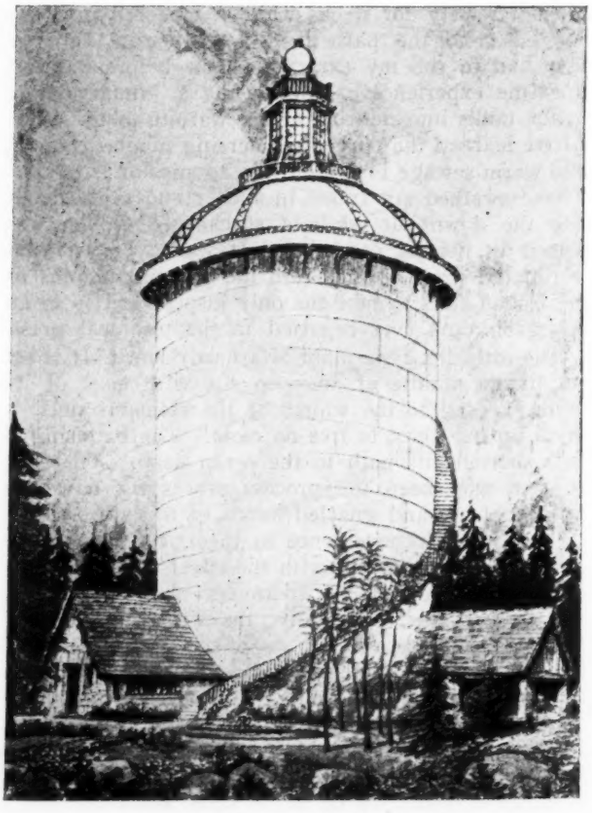
Even the temperature has its effect on sedimentation. Let's not spoil our pleasantries by bringing in the thought that sudden temperature rises in the spring and sudden digestion of solids may cause that evil spirit, foaming, to start its rampage. Why even think of the ice that must be chopped out of a dead reversal channel after a particularly wild winter night? Let's skip over the freezing of the wind-beaten sewage mist that forms treacherous footing on the tanks. We can even disregard the rancid smell of grease curd which develops under the heat of the sun. With all of these phases of temperature effect forgotten, there is still the fact to face that science recognizes sedimentation variations resulting from temperature changes. If this holds true, practically, temperature bears upon the vitals of the problem of tank efficiency.

The tank is a device that takes in sewage and gives off an effluent, sludge—and odors. The effects of the entire gamut of weather whims—temperature, humidity, wind velocity and even barometric pressure—on tank odors are receiving the serious attention they deserve. There is one thing about the winter which is advantageous. It is a strong odor that can develop and succeed in going anywhere. In the summer—well, that's another story. Septic sewage caused by hot weather, a tank with some foaming tendencies, a drop in barometric pressure and temperature accompanied by overturning currents in the tank which bring gas-saturated bottom liquors up into the sedimentation compartment, a belching of methane and some sulphurous gases from the vents—the stage is set. A humid air, a light breeze blowing in the direction of porches populated with home-loving fresh-air seekers in the cool of the evening and the trouble is done. Don't blame the Imhoff. It is at the mercy of the weather. . . .

What is true of the Imhoff tank is equally true of the sludge bed, which waits patiently through the winter for an opportunity to serve in the summer and then is at the mercy of the rain and the moisture-laden air of a humid day. What is true of the tanks and sludge beds is also true of all other treatment devices exposed to the weather without protective covering. That is understood. The importance of good weather sense on the part of the operator needs no stressing, once we are convinced that weather plays an important role in the treatment of sewage, a role so often forgotten.

What is less understood is that a complete record of the weather that passes over the plant units makes a valuable operation document. The records will do much to explain the many variations in operation technic and efficiency. They will explain the poor tank sedimentation, the slow drying of sludge in a wet summer, the fickleness of the filters. The development of a weather-recording station at the sewage works may cost some money but it can be considered a good investment.

Did you ever receive a 'phone call from a solicitous plant neighbor who asks with great interest, "What are you doing down there this morning?" If you have, you know that the query was not out of friendly interest. Oh, no. The odors this morning were just unbearable, that's why the call came through. Something terrible must be going on down there right now. All the explanations in the world would not convince that irate objector that the odors could not possibly be coming from the works. She can, however, believe the weather vane which indicates a breeze coming from the direction of her home toward the plant. The balls of the anemometer whirling away at a rate of five miles an hour convince her that an odor could not buck its way up to her house. The thermometer, the barometer and the hygrometer all say in splendid agreement that no odors could be



San Antonio's new steel standpipe.

coming from the plant. The dials and charts all look impressive. The complainant leaves mollified to hunt the source of odor in the other direction from her home. The weather recording equipment earns its place in your esteem.

The sewage-works is at the mercy of the storm, it is true. The storm, however, leaves its calling card behind on the meteorological records. If things go wrong, it is nice to be able to know why. If they go well, it may be good for the operator's mental equilibrium to know that the weather assisted in the good work.

San Antonio's New Steel Standpipe

The illustration herewith shows the new all-steel stand pipe at San Antonio, Texas, with a capacity of two and a half million gallons. It is to be erected in the south-east part of the city by the Chicago Bridge and Iron Company at a cost of $68,300. Special consideration was given to making the stand pipe as ornamental as possible, as the illustration plainly indicates. The beauty of this structure will be greatly enhanced at night by a specially planned lighting system. This tank can not be regarded as a reservoir, but is only intended to stabilize pressure.

San Antonio's first system of water mains was laid in 1878, water being taken from the river, but since 1900 all of the supply has been from wells. In 1906 the water works was sold to a group of Belgians, who resold it to a group of San Antonians in 1920; who in turn sold it to the city in 1925.

The plant has grown rapidly during the past fifteen years and now furnishes about 23,000,000 gallons a day to 250,000 consumers. The supply is obtained from 28 artesian wells.

The system has no reservoirs, but in order to stabilize pressure, a one million gallon elevated steel tank was erected on the north side of the city near Brackenridge Park, and a contract has been let recently for the erection of the two and one-half million gallon standpipe in the southeastern section which is shown in the illustration, for which we are indebted to the "Muellor Record."

Prizes for Elevated Tank Designs

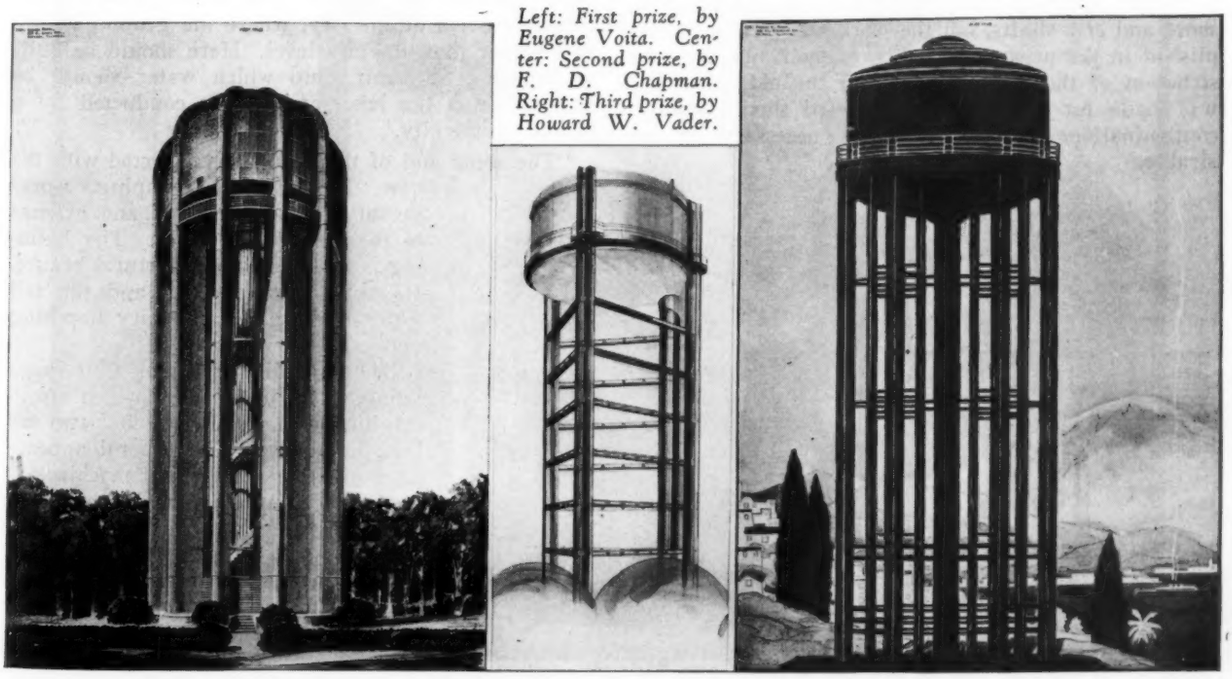
In our November issue we announced a competition for improved design of elevated steel water tanks, sponsored by the Chicago Bridge & Iron Works, with the hope of "developing an aesthetic improvement in the character" of such tanks. There were 691 applications for information and 152 designs submitted, which are said to be "so unusual and diversified in their scope that it is thought that this contest will result in a veritable renaissance of elevated tank design, which will be felt throughout the entire country."

The accompanying illustration gives an idea of the designs receiving the three first prizes—$2,000, $1,000 and $500 respectively, awarded to Eugene Voita, Chicago; F. D. Chapman, Evanston, Ill., and Howard W. Vader, Chicago. Honorable mention, with $100 each, was awarded to Donald A. Blake, Geo. A. Hossack and Mary Ann Crawford of Chicago; Samuel E. Hornsey of Cambridge, Mass., and to Ossip Klarwein and Fritz Hoger of Hamburg, Germany.

Hornell Votes for New Reservoir

The city of Hornell, N. Y., at a special election held in April, approved a $70,000 bond issue for the construction of a new reservoir by a vote of 710 to 190.

This action reverses the previous decision on the same measure, which was defeated in the March elections by a vote of 275 to 259.



Left: First prize, by Eugene Voita. Center: Second prize, by F. D. Chapman. Right: Third prize, by Howard W. Vader.

Designs for elevated tanks receiving the first three prizes of the Chicago Bridge & Iron Works contest

Chicago's Water Works a Half-Century Ago

THE first water works for the City of Chicago was begun eighty years ago, when the population of the city was about 35,000. Sixteen years later the first tunnel into the lake was completed—a five-foot tunnel extending two miles into the lake. The second tunnel, seven feet in diameter, was finished in 1874; it paralleled the first but extended four miles further into the lake. This second tunnel and crib are shown herewith, as is also the pumping station, by wood cuts which accompanied a description published in "Scientific American" just fifty years ago—the issue of May 7, 1881.

Chicago is described in this article as a city "justly noted for its business activity, its bold enterprises, its live way of doing things generally; and the history of the city water supply system, from its comparatively small beginning to its latest development, is characteristic of the progressive spirit that pervades the great Northwest."

The city's first water works were put in operation in February, 1854, "and consisted of one reservoir, containing about a half million of gallons, and eight and three-quarters miles of iron pipe, beside the pumping engine. The population at this time had increased to about seventy thousand, and the growth of the city, together with the introduction of sewerage and the establishment of packing houses, distilleries, etc., increased the quantity of filth flowing into the lake to such an extent that complaints of the impurity and offensiveness of the water were frequently made, and it was proposed to extend an iron pipe, five feet in diameter, one mile out into the lake, to obtain a supply beyond the effect of the sewage."

The first tunnel was commenced in 1864, and the second in 1872. Concerning the latter the 1881 article said:

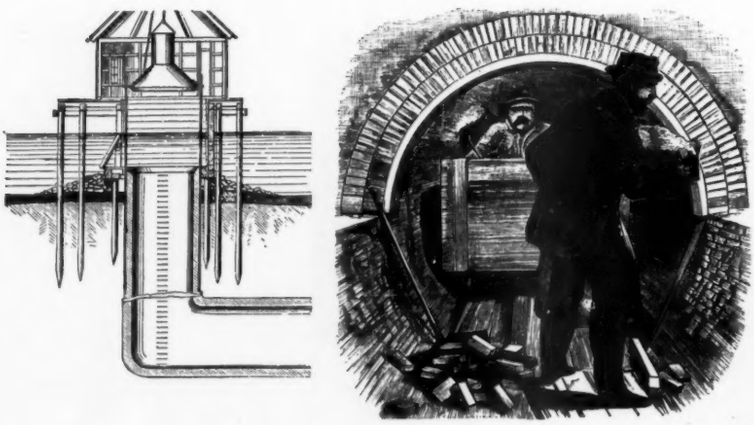
"Great difficulty was experienced in sinking both shore and crib shafts, but the work was finally accomplished in the most satisfactory manner. In the construction of the new tunnel as in the old, provision was made for extending it lakeward should sewage contaminations hereafter make it necessary or desirable.

"The crib is a substantial structure of solid masonry, the three lower courses of which are built of granite, on account of its superior frost resisting qualities. The upper courses are of limestone, the arches are of brick, the filling of rubble, and the deck is composed of ordinary concrete, on the top of which is placed a layer of asphalt concrete. The light-house tower is of brick, with an iron stairway. Upon the deck is built a brick house, in which the family of the person in care of the crib resides. No more desolate and isolated place of residence could be imagined than this is in winter. One might as well be on a desert island as far as human companionship is concerned, although there is a telephone line to the shore. But there are many days when the storms blow and the waves beat in their fury, and the broken, floating ice dashes against its sides, that no one goes out from the shore. It is said that some of those who have lived at the crib have found the isolation so intolerable as to almost drive them insane. In the summer, however, boats constantly ply between the shore and the crib, carrying visitors, it being a favorite resort for boating and sailing parties.

"Since the completion of the tunnel the immense growth of the city has so increased the sewerage flowing into the lake that it is believed that at times it extends as far as the crib, and contaminates the water. Many plans have been suggested to remedy this, and on all hands it is confessed that the problem is a very grave one. It is probable that in ten years from now, with the present rate of increase, Chicago will have a million of inhabitants, and in that case no tunnel extending directly into the lake could insure pure water. The latest suggestion for procuring pure water for the city is that of Chicago's eminent architect, Mr. W. W. Boyington, who proposes that the city shall purchase 100 acres of land in Highlands, some 20 miles north of the city, where the ground is 130 feet higher than the city level. Here should be built an immense reservoir, into which water should be pumped from the lake, and thence conducted by a viaduct to the city.

"The shore end of the tunnel is connected with the new North Side pumping works shown in our engraving, and extends to the West Side works. The building is a model of architectural beauty. Its style is castellated, and the tall water tower gives it a very imposing appearance.

"The building contains four large pumping engines, two of which are in continual use, while the other two are held in reserve. The general appearance of these magnificent machines is seen in the upper view in the large engraving, the last one erected being shown in the foreground. This is a double engine, having a capacity of 36,000,000 gallons in twenty-four hours. The steam cylinder is 70 inches in diameter, stroke 10 feet. The water



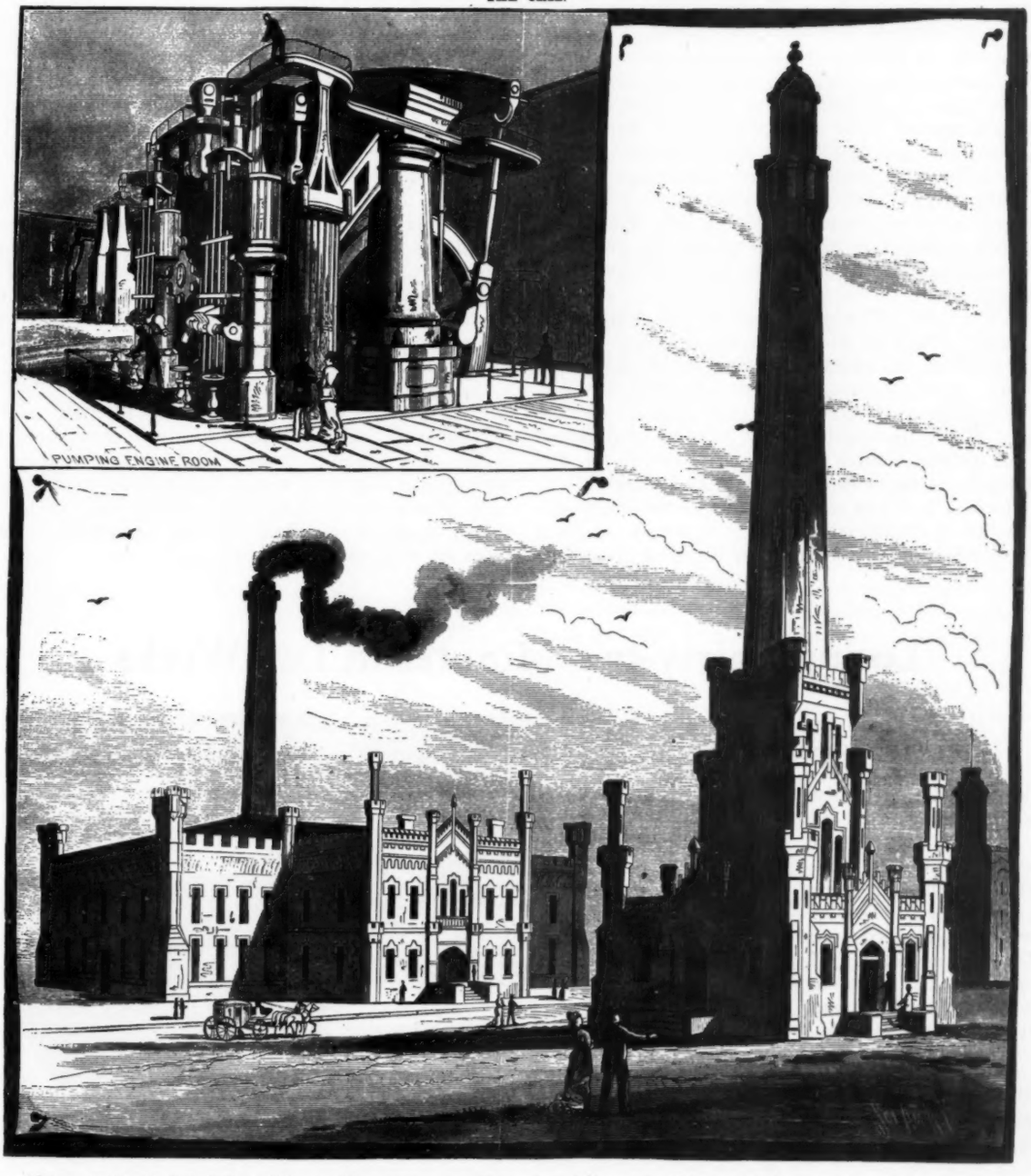
Above—The first crib, showing cast iron rings and gate. At right—section of tunnel under construction.

(Continued on page 60)

Of the pumping engines shown below, the one in the foreground is a double engine having a capacity of 36,000,000 gals. in 24 hours. Steam cylinder, 70 in. diameter and 10 ft. stroke. The fly wheel weighs 40 tons.

THE CRIB.

Concerning the building below, "Scientific American" said in 1881: "The building is a model of architectural beauty. Its style is castellated, and the tall tower gives it a very imposing appearance."



Chicago's North Side Water Works fifty years ago. Reproduced from the "Scientific American" of May 7, 1881.

Treating Water to Prevent Ferruginous Encrustations

Considerable has been written in the United States, during the past two or three years, about the advantages of adding alkalis to certain waters to prevent encrustations in iron pipe, and opinion generally seems to favor it. The subject has been discussed in England also, but the idea has not, we believe, been tried out in as many cases. Discussing it in a recent issue of "The Surveyor," Arthur Goffey said:

Upland soft waters such as are increasingly forming the supply to many of our large industrial towns have in the raw state a pH value of 5.6 to 6.4 which is decidedly on the acid side of neutrality, and also contain various forms of iron bacteria, the pH value having an influence on the predominating form. Information on this point is almost non-existent, but a recent series of observations seems to indicate that crenothrix appear in the more acid waters; leptothrix, gallionella and spirophylla are fairly general in distribution with an optimum growth slightly on the acid side of neutrality; while cladothrix dichotoma have been observed in an alkaline water of pH 7.2. Dissolved iron which has been picked up by these acid waters favours the existence and activity of these organisms.

As is well known, any bare patches or pinholes in the coating of a pipe form the starting places for the formation of the encrustations owing to the production of local concentration cells of dissolved iron, which favour both the corrosion of the pipe material and the activity of the iron bacteria. It may be emphasized that the ultimate source of the encrustation is the dissolved iron in the water itself, as the volume of deposit formed is out of all proportion to the slight pitting which is usually all the signs of attack observed on the pipe. Graphitisation is the result of direct corrosion, and although encrustations are usually associated with it, is really a different phenomenon. The exact mechanism of the deposition is obscure, but it is largely due to precipitation by bacterial action, direct precipitation by agitation and evolution of dissolved oxygen in eddies round the tubercle, and possibly deposition by electrolytic action.

The addition of lime or other alkali to the water will counteract the action of the acidity, but has less effect on the bacterial action, which is merely slightly retarded, no real benefit being realized until a pH value of about 8.0 to 8.5 is reached, when the existence of iron bacteria is inhibited. Deposits have been examined which were associated with iron bacteria and which had a content of 14.8 per cent of calcium carbonate. Additions of lime in sufficient quantity to be effective are costly, and prejudice the suitability of the water for certain technical processes such as dyeing and general textile processes. No material benefit is obtained by hardening the water until a hardness of 25 degrees to 30 degrees is reached, which, of course, rules out this method. The addition of sodium silicate has been tried, but no useful results are seen until prohibitive concentrations are reached. It may be generally accepted that elimination of encrustations of this nature cannot be effected by the addition of chemicals without prejudicing the desirable qualities of these soft waters. Filtration will remove a proportion of the iron bacteria, but even the most efficient slow sand filtration cannot completely remove either them or the conditions facilitating their growth.

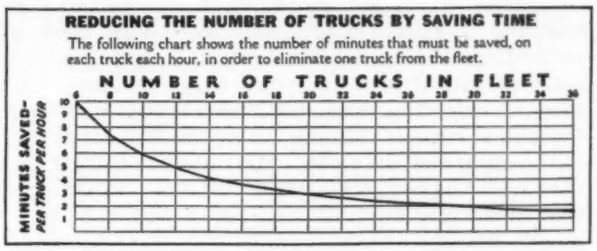
Scraping operations to remove this kind of deposit will in general tend to destroy any softened protective coating on the pipes, and accelerated redeposition will usually occur. The only sure means of preventing this is to recoat the pipes after the scraping, which can now be done successfully, or to lay pipes in which the chance of the occurrence of bare exposed iron is reduced to a minimum.

Losing Thirty-two Minutes in Two Weeks

THE Erickson Paving Company, Inc., Seattle, Wash., recently established what is claimed to be a world's record for sustained efficiency in pouring concrete on pavement construction. During a period of two weeks, concrete was delivered from the mixer to the road-bed with only 31.62 minutes of avoidable delays (delays due to inefficiency of crews or defects in equipment). On this job Fageol trucks, equipped with batch bodies and Heil hoists, were used. The illustration shows trucks lined up waiting their turn to charge the mixer. The inset shows a truck dumping.

(Valuable pointers on saving time on concrete road construction were contained in an article by P. M. Tebbs, published in September and October, 1930.—Ed.)

Operating Motor Trucks Profitably in Contracting



The second in a series of articles on saving money on motor truck operation, based on a nationwide survey made by the General Motors Truck Co. and presented in a slightly condensed form with their permission

TIME-SAVING in loading, routing, and unloading, all contribute to more profitable operation of truck equipment in contracting. A fourth type of time saving, however, is at least equally important—and sometimes even more essential. This factor is the reduction of *time lost in the shop.*

The Cost of Repair Time.—Time spent in the repair shop is waste time. And its cost may easily become a serious cause of loss—especially in the case of a contractor operating a fairly large fleet of his own trucks.

When truck equipment is laid up in the shop, the loss to the operator is immediate and direct. To begin with, he faces the cost of the repairs themselves. But that is only one portion of his loss. On top of that he has the loss from idle time of the truck—the cost of providing extra equipment to take the place of trucks being repaired—the cost of delays on the road and delays on the job.

To prevent or reduce these losses requires well-planned, consistent effort along two lines:

Scheduled maintenance, strictly enforced.
Thorough training of drivers.

A SIMPLE BONUS PLAN

The most effective bonus plan for drivers consists of a flat bonus of $15 a month for good performance, with deductions according to some such schedule as follows:

$2.50—accidents caused by driver
2.00—violation of safety rules
1.00—repairs due to poor driving
1.00—failure to report needed repairs
1.00—proven loafing on job

Four Steps in Maintenance.—The first requirement in keeping trucks out of the repair shop for any length of time is to bring them into the shop frequently enough for preventive maintenance. Many major repairs are the direct result of failure to correct minor troubles promptly. For that reason, any contractor who operates a fleet of trucks on fairly steady work should set up a definite maintenance program which can be enforced regularly. The four main steps in this maintenance program should be as follows:

1 *Daily reports by drivers on the condition of the trucks*
2 *Oil change, greasing, battery inspection, and tire inflation on regular schedule.*
3 *Complete, thorough inspection at regular mileage intervals.*
4 *Yearly overhauling during slack season.*

The first of these steps—a daily report by the driver—is the fundamental factor. The driver who runs the same truck day after day should know better than anyone else what troubles are developing. His constant cooperation will assist in the preventive work that cuts down major repairs. And his cooperation can be obtained by (1) giving him a definite routine to follow, and (2) giving him to understand that prompt reports of trouble count in his favor and are not regarded as black marks against his driving record. A suitable form for his daily report was shown in the May issue.

Training Drivers to Reduce Costs.—In any effort to reduce maintenance costs on truck operation, the key man is naturally the driver himself. This has been abundantly proved by the experience of large contractors who occasionally find it necessary to switch drivers from one truck to another. In virtually all such cases, differences in individual responsibility of drivers register almost instantly.

The extent to which drivers can be trained to take pride in their trucks and assist in reducing repair costs, is, of course, dependent on the steadiness of their employment and on the supervision that can be given them. In some instances, contracting firms

handling a fairly steady volume of such work as excavating and road building have found it practicable to give drivers rather thorough training. An eastern contracting firm, for instance, puts its drivers through a regular training, along the lines indicated in the outline at the right. Meetings are held at regular intervals to discuss these subjects. When occasion offers, the meetings are also used for talks by service experts of truck manufacturers or by representatives of manufacturers of special auxiliary equipment.

Organized Effort Reduces Loss.—While not every contractor, of course, can profitably undertake a training program so systematic as this, it is well to remember that everything that can be done to reduce excessive repair cost will contribute directly to more profitable operation. Many contractors, unfortunately for themselves, are content to hire drivers, put them to work with little or no instruction, and then periodically jerk them up when their work shows shortcomings. Ordinarily, this procedure accomplishes little or nothing. The damage is done before any effort is made to prevent it.

Drivers Must Have an Incentive.—Training alone, of course, will not eliminate unnecessary maintenance expense. To produce results worth getting, the training must be backed up by a definite incentive for better performance.

The best incentive, usually, is some form of bonus plan which gives the driver a financial interest in the economical operation of his truck. Many such plans are in use. One successful plan is shown on page 33.

CHECK LIST FOR MAINTENANCE PRACTICE

Check completeness, thoroughness, and scheduling on these points:	Yes	No
Are individuals in charge of truck maintenance required to read and know the manufacturer's service guide for the truck or trucks they handle?		
Are they given definite schedules for maintenance operations?		
Are drivers required to report the condition of trucks fully, each day?		
Is there careful supervision to see that minor repair needs are reported promptly and taken care of immediately?		
Are repair schedules arranged, whenever possible, to provide for maintenance during hours when trucks would otherwise be idle?		
Are suitable tools for maintenance, and all necessary materials, always available?		
Is tire inflation checked and corrected each day?		
Is crankcase oil changed at regular intervals, as specified in the truck manufacturer's service manual?		
Is greasing and oiling of all parts handled at regular specified intervals?		
Are trucks washed at frequent intervals?		
Are brakes, steering gear, and engine inspected and tested at least every 1,000 miles?		
Are trucks brought in for more complete inspection at regular mileage intervals as specified by the manufacturer?		

Does this inspection call for the mechanic to cover the following items?

To check:	Yes	No	To check:	Yes	No	To check:	Yes	No
Engine for idling			Generator bearings			Brakes, adjust or re-line		
Engine bolts, mounting			Battery charge			Oil and grease leaks		
Bearings for sound			Terminals and wiring			Cab comfort		
Radiator			Steering gear			Oil feed		
Breaker points			Fuses, lights, signals			Clutch action		
Spark plugs			Dash instruments			Tire tread and wear		
Valve tappets			Speedometer cable			Condition of hoist		
Generator brushes			Drive shaft, rear axle					
Compression			Universal joints			Condition of winch		
Fuel system			Front wheel spindles					
Fan and water pump			Body and fenders			Condition of other auxiliary equipment		
Magneto bearings			Springs					

Do mechanics have an inspection sheet or card listing these items for their guidance during the inspection and requiring their O.K.?		
Are rewards offered for effective maintenance, with penalties for neglect?		

Check list for maintenance practice. This provides a simple, accurate means of testing maintenance practice. When a check-up has been completed, an immediate study of present methods will indicate weaknesses to be eliminated.

OUTLINE OF TRAINING PROGRAM FOR DRIVERS

1. **Filling out daily reports.**
2. **Detecting and reporting defects in truck equipment.**
3. **Avoiding delays.**
4. **Reporting accidents.**
5. **Operating of hoists, winches, and other equipment.**
6. **Loading correctly.**
7. **Handling the truck to extend its life.**
8. **Saving time and mileage by correct routing.**
9. **Avoiding accidents.**
10. **Obeying traffic rules and laws.**

Turning Time Savings Into Profits

In truck operation, of course, time saving is not an end in itself. The value of saved time depends upon the *results* of the saving, not upon the saving itself. But time saved by better loading and unloading, by better routing and driving, and by avoidance of breakdowns and repairs, shows up quickly in definite profits to a contractor. Even though a few minutes here and there may seem relatively unimportant, the total saving resulting from more careful truck management often leads to measurable gains.

Automatic Savings from Better Management.—The benefits of time savings show up first in the form of lower payroll costs on the job itself.

—Delays caused by inadequate material supply are eliminated or made less severe. Thus schedules become easier to meet; penalties are avoided; and layoffs and idleness are reduced.

—There is less need for overtime for labor and for trucks. With steady, reliable transportation of materials, overtime for workmen on the job, and for truck drivers, becomes less likely to be necessary.

These big savings alone may be enough to warrant constant attention to the problem of saving time in truck operation.

Reducing the Number of Trucks.—Beyond the automatic savings on the cost of labor, however, lie other possibilities of increasing profits by reducing the investment in truck equipment or the cost of hiring trucks. On large operations, a very small saving in time, on each truck, may make it practicable to handle the movement of materials with fewer trucks. In a fleet of 12 trucks, for example, a saving of 5 minutes an hour on each truck will enable the operator to handle the same tonnage or yardage with 11 trucks instead of 12. In a fleet containing 20 trucks, a saving of 3 minutes an hour on each truck will accomplish the same result. The larger the fleet, the smaller the time saving needed in order to eliminate one truck.

This is the second of a series of articles showing the way to more profitable truck operation. The Next will appear in the July issue.—ED.

THE EDITOR'S PAGE

The American Water Works Convention

The opening session of the convention of the American Water Works Association at Pittsburgh occurs on *Monday* morning, May 25th, and not on Tuesday as heretofore. Monday afternoon come the Superintendents' Round Table Discussion, discussion on standard methods of water analysis and meeting of the Board of Directors. Then comes the "Service des Eaux" dinner, and that evening the informal reception. This ought to bring to Pittsburgh on Sunday or Monday every one who is interested in any phase of the water works field. From then on there is an almost continuous three-ring performance, until Friday, all of which is devoted to a subject of special interest this year—finance.

The three rings are occupied by the main sessions; the water purification division and then the finance and accounting division; and the exhibits. The first will include metering, tastes and odors, boiler feed water, corrosion of mains, gravel well, elevated tanks, service pipes, sub-aqueous pipe lines, aerial maps, plant management and operation, water works funds, attractive appearance of water works structures, the 1930 drought, assumptions in designing, rainfall and streamflow records.

The second ring will afford lucubrations anent chloramines, activated carbon, manganese, ammonia-chlorine, bio-chemistry of streams and other things we all know *of* but only the high-brows know much *about*. The finance and accounting division will furnish abundant information about methods of acquiring money and of spending it, office methods, billing equipment, public relations, personnel, rate making, plant inventory, etc.

In the third ring will be a continuous display of exhibits. A new attraction this year is the opportunity to vote for the exhibit which you think the most instructive, the one getting the most votes to receive a prize. Study them all well—and beware the vote-getting wiles of the pulchritudinous attendants at the booths.

Popular Taxes

It has been reported so often and from so many sources that it must be true, that there is practically no opposition by automobilists to the gasoline tax. And the reason given is that they understand that the money so paid is used to improve the roads for their use and that they are getting good value for it, and pay in proportion to the amount received. In some states all expenditures on all the main roads are met by gasoline taxes and auto registration fees; the latter being in the nature of a ready-to-serve charge.

Some legislators are threatening this fortunate popularity of the tax by using the proceeds for other purposes than roads; only a little as yet, and generally for a popular cause like schools, but with the wedge entered there is no telling how far it will be driven. All auto owners—and that means ninety percent of the population—should resist any diversion whatever of gasoline taxes and auto license fees from highway purposes.

Would not the same ideas apply to other public functions? Water, for example? In some cities the water department's finances are kept separate from all others; it receives and retains all returns from water rates, and pays from them all expenses, including interest and sinking fund charges. In others, all water income is paid into the public treasury and all expenses are paid from it—"and never the twain shall meet"; or if they do no one can prove it. The water consumers might claim that they were paying twice as much for this service as necessary, and no one could disprove it. Or taxpayers might claim that large water consumers were paying much less than cost, the deficit being met from general taxes—again without the possibility of disproval.

Good water, even the highest grade of manufactured product, is the cheapest thing any citizen receives except air. If he knows that all that he pays for it is used with reasonable economy in providing it, and that he pays no more per gallon than any other consumer, only the confirmed kicker will fail to pay his water rate with a smile. This means a financially independent department and universal metering; and a management which uses intelligent endeavors to convince the consumers of the reasonableness and impartiality of its charges. As shown in an article in this issue, nearly half the water departments in the United States meet the first requirement; and we believe that more than half the superintendents meet the last. Here's hoping for the day when one hundred percent of departments and superintendents qualify.

It Pays to Deal with Responsible Firms

The water commissioner of a western municipality writes us: "We installed in 1929 two gravel and sand pressure filters and paid a lot of money for same, bought from the ———— Co. of Chicago, and they have been worthless to us. Every time we have tried to use them the sand has come out into the mains and causes a world of trouble. We are out the price of tanks, gravel and sand, building and installation, which is a total loss to us."

We have looked in all the general engineering and water works periodicals which reach this office (and this includes practically all of them, we believe), and do not find that the company from which these filters were purchased advertises in any of them.

In an editorial in PUBLIC WORKS for May we said: "With few if any exceptions, firms which have been selling reliable goods for a number of years, advertise them. It is *possible* that good equipment can occasionally be had from non-advertisers; but it is *certain* that only properly built equipment, produced by responsible firms, can be advertised successfully over a considerable period of time." The one who wrote the above communication had not, we believe read this editorial before doing so; but if he had, he could not have confirmed it more fully.

The old saying "It pays to advertise" we would supplement with "It pays to deal with the advertiser."

Effect of Drought and Hard Times on Sewage Treatment at Worcester, Mass.

THE sewage treatment plant at Worcester, Mass., which started operation in 1925, consists of grit chambers, screens, Imhoff tanks, dosing tanks, trickling filters, secondary settling tanks and sludge drying beds. This succeeds other methods of treatment used before Imhoff tanks or trickling filters had been heard of; chemical precipitation and sludge pressing were in use twenty-five years ago.

The basis of design was 28 m.g.d. The maximum discharge last year was 45.1 m.g.d. and the average 17.54 m.g.d., an average of 92.3 gal. for each user. The leakage into the sewers is estimated to be 4 m.g.d.

The grit from the two grit chambers is used to fill nearby low areas, and the screenings are buried nearby. The sludge from the 12 Imhoff tanks is drawn onto drying beds in summer and onto land in winter. The sludge from the four secondary settling tanks also is pumped to drying beds. There are 22 beds totaling 21.95 acres, made from old sewage sand filters. Part of these are cleaned by means of a Barber-Greene loader and part by hand. The sludge is dumped adjacent to the drying beds.

Improvements have been made in the appearance of the grounds around the plant by landscaping as funds were available. Several thousand three-year-old pine trees have been set out which in time will serve to beautify the surroundings.

The bar screens originally constructed had 2-inch openings and were raked manually. Last November these were replaced with two mechanically raked Evers-Sauvage bar screens with 1¼-inch openings, the raking mechanism of each screen being operated by a 2 h.p. motor. The object of changing the screens was to increase the quantity of rags removed from the sewage. (Collections of rags about the inlets to the sludge pipes in the hopper bottoms of the Imhoff tanks has caused difficulty in drawing sludge from the hoppers.) John H. Brooks, Jr., superintendent of the sewer department, says: "They promise to be extremely satisfactory and are expected to eliminate past trouble at the Imhoff tanks due to rags."

Top and bottom views of Worcester's new bar screens

Dry weather and depressed industrial conditions combined to decrease the sewage flow from a daily average of 20.77 m.g. in 1929 to 17.54 in 1930. They also caused some variations in the operation of the plant, due to some extent, it is believed, to the reduction in the iron, acids and alkalis discharged into the sewers by the industrial plants.

Imhoff tanks. In 1930 the dry solids in Imhoff tank sludge totaled 5,253 tons as compared to 6,020 tons in 1929; and the sludge removed contained 6.35 per cent dry solids in 1930 and 6.78 in 1929.

The suspended solids content of the Imhoff tank effluent was 117 p.p.m. by the Gooch determination and 102 as determined by differences in monthly determinations of total solids in unfiltered and filtered composite samples; while in 1929 these figures were 118 and 123 respectively. The suspended solids content of the sewage was less in 1930 than in 1929. Said Mr. Brooks: "It is apparent that decreased quantities of industrial wastes in the sewage more than offset an increased concentration of the sewage which would be expected on account of the dry weather. The only result of analysis of sewage which shows greater concentration of polluting matters is the biochemical oxygen demand."

The average soluble iron content of the sewage decreased from 34.0 p.p.m. in 1929 to 23.2 in 1930, and the total iron decreased from 56.3 to 47.2 p.p.m.

Trickling filters. In several respects the trickling filters behaved better during 1930 than formerly, probably due in part, at least, to the less number of extremely acid or alkaline doses of industrial wastes in the sewage. No trouble was encountered with excessive pooling on the surface of the stone, nor were flies offensively numerous. On the other hand, the nozzle cleanings necessary increased 8 per cent although less tank effluent was treated.

For the first time since the filters were put into service the nitrogen as free ammonia content of the effluent was reduced to from 1.0 to 1.5 p.p.m. during the fall months—the best months of operation; the reduction averaging 92.0 to 94.5 per cent. The rate of filter operation was 1.12 million gallons per acre per day in 1930 and 1.16 in 1929, but this was too little difference to account for such result; nor does the pH of the filter influent, which varied from 6.6 to 6.9.

"Lack of industrial sewage in an abnormally dry year," said Mr. Brooks, "resulted in an average sew-

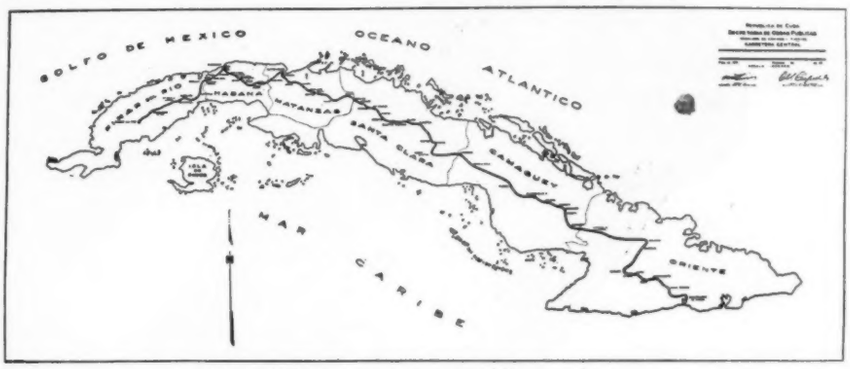
(*Continued on page 83*)

La Carretera Central de Cuba

By Lyle A. Brookover

AFTER four years of work, chiefly with machinery of United States manufacture and Cuban labor, the Central Highway of Cuba (Carretera Central) has been completed, and now winds through city and country, mountain and plain, for 708 miles from Pinar del Rio to Santiago de Cuba. It was dedicated February 24th, 1931. It cost $100,000,000.

All of this cost, however, is not chargeable to highway construction. All the "returns" or entrances to side roads and farms were paved, in some cases for a considerable distance, and entrance arches of concrete were built occasionally. Parks were built at entrances and in the central part of towns and villages, and in cities like Matanzas, Pinar del Rio, Santiago de Cuba and Consolacion del Sur they were of great size and were beautified with statuary and flowers and shrubbery. While they added materially to the cost budget, they also add tremendously to the scenic value of the highway.



Map of Cuba showing route of Central highway.

Sidewalks and sewers were installed through municipalities and the roadway width was increased to 8 meters. A hospital was built in Santa Clara as a part of the highway contract.

Cont. on p. 78

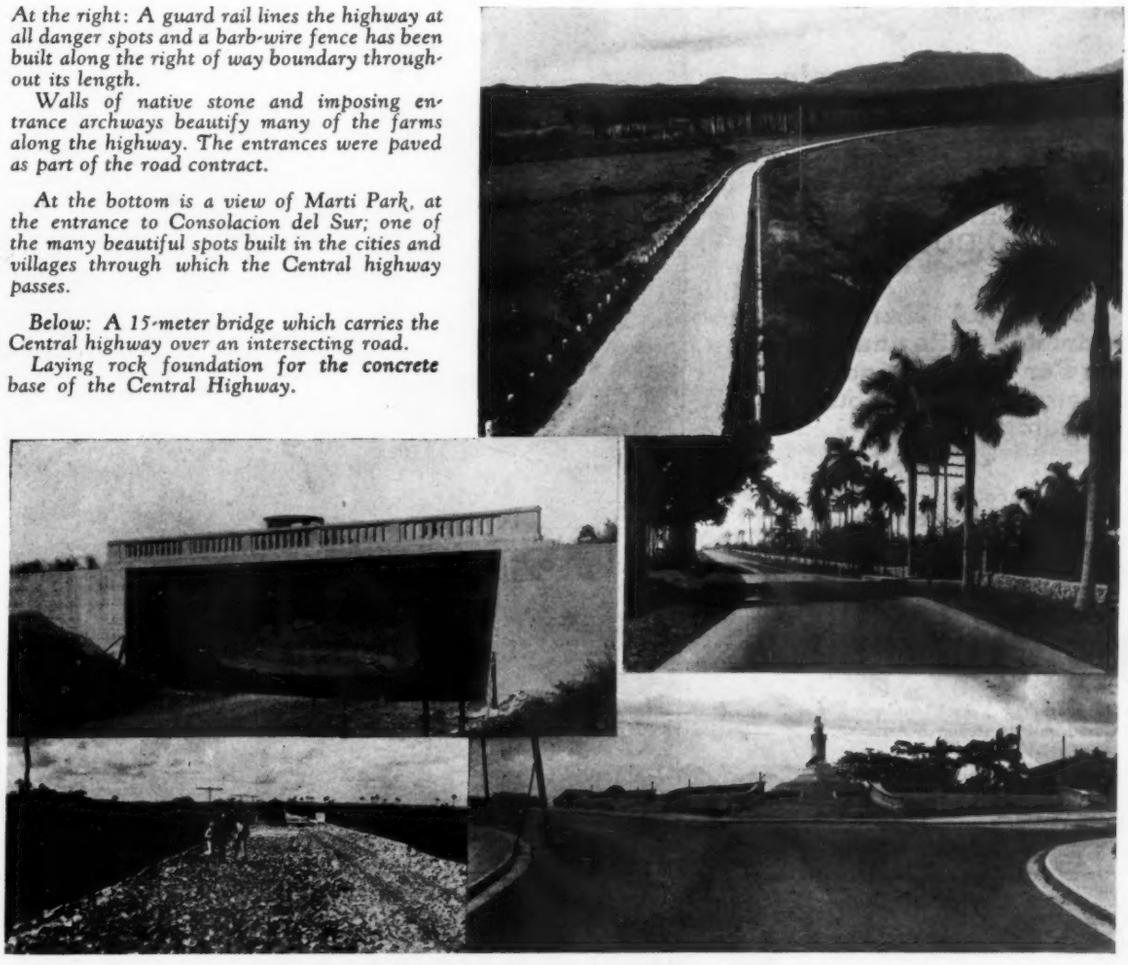
At the right: A guard rail lines the highway at all danger spots and a barb-wire fence has been built along the right of way boundary throughout its length.

Walls of native stone and imposing entrance archways beautify many of the farms along the highway. The entrances were paved as part of the road contract.

At the bottom is a view of Marti Park, at the entrance to Consolacion del Sur; one of the many beautiful spots built in the cities and villages through which the Central highway passes.

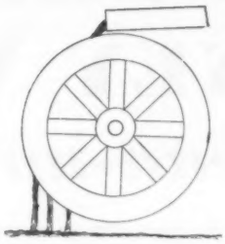
Below: A 15-meter bridge which carries the Central highway over an intersecting road.

Laying rock foundation for the concrete base of the Central Highway.



For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 93

THE WATER WHEEL



By
Jack J. Hinman, Jr.

Design

STUDIES of the **deflections of dams** in comparison with those of mercury-loaded small scale **models**[4] have shown these miniature structures to be of great value in dam design. Models were also found to be valuable in the preparation for the reconstruction of a large **spillway** on the Yadkin river in North Carolina.[5] Fundamental studies in which models of a wide range of sizes have been employed are being carried out at the **great German hydraulic laboratory** at Walchensee, near Munch,[6] and in hydraulic laboratories elsewhere.

A study of the **failure of the Lafayette dam,** near Oakland, California, completes a series of articles by C. E. Grunsky,[53] covering several **dams and reservoirs.** New projects include the **Madden dam** project at Alhajuela, Canal Zone,[94] and the **Old Mill Stream** project which is to increase the water supply of Wilmington, Delaware.[38] In connection with the Madden dam, investigations were made by the representatives of the U. S. Geological Survey. The service which is offered to water works people by the **state geological surveys** is described by Landes, of Kansas.[57]

The use of **admixtures in concrete** and their effect upon workability, strength, durability, uniformity and other essential characteristics is discussed by McNown[76] who arrives at the conclusion that the benefits, if any, be set against the disadvantage of requiring an additional material to be obtained, stored and separately placed in the mix.

In the design of distribution systems the **fire stream capacity** may be given insufficient attention in the portions of the city where the greatest fire hazard exists. J. O. Jones[60] sets forth the necessary considerations with regard to the provision for the required number of streams. Changing developments in a community may require a very different set of conditions to be met when extensions are to be designed for the distribution system. Nevertheless each city or town should arrange for a definte systematic growth of the pipe lines without the introduction of undue friction from the use of pipe of too small diameters. The solutions of the problems of the designer of **extensions** are thus facilitated.[61] **Water hammer** and its effects may be controlled if the causes and manner of action are understood.[52] Frequently it is advantageous to gain an idea of the amount of water required by apartment houses, hotels and other large buildings.[7]

Special properties are claimed for **sand spun pipe** which is made by centrifugal casting of the pipe in a sand lined mold.[37] In some cities **cement lined pipe**[50] has been used for many years with satisfaction. At Danvers, Massachusetts, wrought iron cement-lined pipe has been in use for 54 years. A sixteen inch cast iron pipe line which was salvaged recently at West Palm Beach, Florida, was cleaned and cement lined for further use.[32]

The employment of **diesel engines** for pumping plants in the United States has aroused interest in Great Britain. The high relative efficiency of small units is a material advantage for small plants.[80] When **electric motors** are to be used for pumping, the characteristics of the motors should[66] be fitted to the particular needs of the pumps and their manner of use.[55] The fact that the discharge of **centrifugal pumps** varies as the speed, while the head varies as the square of the speed and the power absorbed varies as the cube of the speed, is reviewed by F. Johnstone Taylor[83] who emphasizes the need of a study of the characteristics of the pumps in order to forecast their performance. The **automatic pumping station practice** of the city of Baltimore is described by Leon Small,[81] who is of the opinion that these stations can be used to excellent advantage for small high pressure districts.

The subject of **water witching** comes up from time to time. Recent experiences with water witching at Marshalltown, Iowa, have left H. V. Pedersen, the manager of the water works, wondering if there is something to the process after all.[41] Abel Wolman[43] in commenting upon the circumstance gives references to recent articles on the subject.

Mr. A. G. Fiedler, of the U. S. Geological Survey, has been engaged in a study of methods of **well drilling** for some years. He summarizes his conclusions about proper well drilling procedures in an article which is published in several journals. [56, 106, 25] Methods in use for **raising water** from wells are described by Allen and Millington.[8, 78]

Considerably more attention to the **architectural embellishment** of water works plants has been evident lately. The architecture of the new Springwells station at Detroit is discussed by the architect, John C. Thornton.[95] Mr. Baylis concludes his valuable article on the design of **sedimentation basins** with a discussion of self cleaning basins. He lists 83 references. **Swimming pool design** is the subject of a paper by M. P. Hatcher, of Kansas City,[75] read at the recent meeting of the Kansas Water Works School.

Construction

A series of **accidents** during the construction of the tunnel from Yonkers to Brooklyn, known as Tunnel No. 2, raised the question whether or not the work was being pushed at reckless speed. It is stated that there have been 44 fatalities, but an investigation[21] found the report that reckless haste was responsible for them, to be untrue. The cost of the work amounts to about 43 million dollars and the excavation reaches points from 380 feet to 780 feet below the surface.

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In Indianapolis a **new conduit** is being built to connect the filter plant with the high service pumping plant nearly a mile away. The line will be 54" concrete pipe in 12½ foot lengths six inches thick. It is of copper bell type, molded in steel forms. Leadite joints are used. A feature is a remote control venturi meter.[16] Baltimore is constructing an **84" concrete conduit** about 14,000 feet long.[15] A six foot conduit from Elwa river to Port Angeles, Washington, a distance of 8 miles, has about 1½ mile of tunnel. In this distance about 1 mile must be put through **loose gravel** which caused much difficulty by the manner in which it would run into the working.[11] A symposium on **main laying** in England[84] brought out considerable difference of opinion about desirable practices.

Leominster, Massachusetts, **water works employees have rebuilt** the old No Town reservoir, built by an association of mill owners in 1853. At an expense less than $27,000 it was fitted up for additional city water supply.[98, 103]

Description of plants have been numerous in the literature. Among the communities whose systems have been described are: Atlantic City, N. J.,[51] Independence, Kansas,[73] Lincoln, Kansas,[72] New Brunswick, N. J.,[30] Kitchener, Ontario,[3] Rangoon,[90] Singapore,[86] Rhosneigr, Anglesey,[79] and Shipton, England.[87]

Management

The **business affairs** of a public utility involve a great many different matters besides the supervision of the technical work.[65] Occasionally the **contractor may finance** the construction of the plant as at Havre, Montana.[20] Usually, however, the financing must be conducted by the owners themselves. Mr. George H. Fenkell shows, moreover, that there are many other **problems for the water works executive,** including ever-present political considerations.[2, 109] The water works superintendent has a host of things to keep in mind and to do, if he makes the most for himself and for the community out of his job, as W. Scott Johnson would have him do.[108]

The Public Service Commission of New York was given jurisdiction over **private water companies** within the state, by the General Assembly of the State of New York, just before the adjournment.[14] New York City has purchased the Long Island Water Corporation which supplies the Rockaway section of the city.[18] In a great and complicated water supply system such as that of the City of New York many problems must be dealt with. Mr. W. W. Brush, the chief engineer, tells how some of these problems have been solved.[97, 107] Paris, Kentucky, has purchased the private company which until now has furnished it with water.[13] Riverside, California, voted not to join the Metropolitan Water District of Southern California,which expects to draw water from the Colorado river.[17] Riverside believes that sufficient water reserves are available for the needs of the city.

Water waste prevention by universal metering and frequent leakage surveys is advocated by David A. Heffernan, of Milton, Massachusetts.[47] **Mechanical accounting** suitable for water works offices can be profitably installed according to P. H. Hutchinson. The procedure may be fitted to the type and amount of the work to be done.[35]

Legal matters discussed in current water works literature include the law as to **taxation** and **payments for water works systems**[100] and the legal phases of **water storage** as interpreted in the Rocky Mountain states.[31]

Operation

Thawing frozen water pipes was first attempted in the early days by using hot water and steam later on. Nowadays electrical methods are preferred. When mains are thawed out, rust is frequently disengaged from the walls of the pipe. This material itself may cause further stoppage.[49] **Break in mains, service pipes** and hydrants were the subject of a symposium at a recent meeting of the New England Water Works Association.[48]

Corrosion of piping and boilers is found in many localities. In some unusual cases the cause is hard to detect. Internally generated electric currents and distilled waters at high temperatures have been involved.[34] Conservation of **underground structures** requires constant attention to the peculiarities of the local conditions.[33]

Private **cross connections** continue to exist as distinct menaces to the safey of public water supplies in many localities and constant watch must be kept to insure that new ones are not installed or that plumbing does not offer the possibility of back-siphonage at times of low water pressure.[29] Long new aqueducts require careful disinfection. Close supervision over the **disinfection of the new Wanaque aqueduct** disclosed the fact that it took over five days for a heavy dose of chlorine to travel 20.5 miles, and show residual free chlorine at the outlet.[44]

Filter operators are often troubled with **short filter runs** and find that the difficulty is due to too high a turbidity in the applied water, to a large number of microorganisms in the water or to air binding. Sometimes mud balls are involved. In winter, because of the greater viscosity of the water, there may be loss of filter sand. Taste and odor troubles occur from time to time. The experienced filter operator has means to combat these difficulties more or less successfully, according to L. B. Mangun.[66] Control of wash water rates by a study of sand expansion is described by George F. Gilkison, of Kansas City, Missouri.[70] A submerged light on a graduated rod makes it easy to determine the extent of the **expansion of the sand bed** during filter washing. At Kansas City, sand bed expansion of 40 to 45% is satisfactory and keeps the sand in good condition. Larger volumes of wash water are required in warm weather. The variation of the wash to secure a given sand bed expansion does not result in a saving of wash water throughout the year, but it does help to avoid mud ball troubles and to secure adequate washing.

Distinct advantage of **combining aeration and chemical mixing** is claimed by Herman Anderson[63] in connection with the use of the Aeromix device. **Sodium aluminate** treatment is urged by G. J. Fink as a means of securing more efficient softening where municipal water supplies are treated by the lime or lime and soda process.[99] In heavy sludges resulting from settling water as at Kansas City, it is found that more than 15% of solids in the sludge results in stratification. Consequently **too thick sludge** is undesirable and material should be removed in sufficient volume to prevent undesirable thickening.[42] **Ammonia** in water treatment continues to receive marked attention.[71]

Odor and taste control in water supplies by activated carbon, by superchlorination and dechlorination, by the ammonia-chlorine process and by other procedures is eagerly studied in the effort to make water supplies better suited to the demands of the public.[45, 62] Adams[89] in Great Britain, is making a thorough study of substances, which are likely to be found in waters,

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Ground Water Recovering From the Drought

RAIN falling upon the ground naturally enters the soil and gravitates to the ground water, raising its level, providing the ground is porous enough to absorb it as fast as it falls. But to reach the ground water it must pass through the root zone, and vegetation absorbs some—sometimes all—of it. In fact, as a rule there is little or no replenishment of the ground water supply during the summer and autumn. But after vegetation becomes dormant, each rain increases the supply until the soil contains all the moisture that it can hold, after which the rain water that seeps into the soil percolates downward to the water table, or upper surface of the zone of saturation. This is the water that subsequently issues from springs or supplies the wells.

The U. S. Geological Survey for several years has maintained near Washington an observation well on which is an automatic recorder of the ground-water level. Also, through cooperation of the Pennsylvania Geological Survey, monthly measurements are made of the water levels in two shallow wells in the northern part of that state.

At the Washington well the water level began to rise in January, 1929, and continued to rise probably until May, and the total rise was somewhat more than 2 feet. The water level then went down until the middle of January, 1930, when it stood about 1 foot lower than at its low stage in 1929. From the middle of January to about the end of April, 1930, the water rose a little more than 2 feet, but from early in May, 1930, until late in March, 1931, the water level declined continuously, though at a much slower rate during the winter than during the preceding summer and autumn, and the total decline during this period was about 3 feet. On March 28 the water began to rise, and by April 18 had risen 6 inches, but was still about normal. In the Pennsylvania wells the ground-water replenishment began earlier.

The failure of the water level to begin to rise as early last winter as in the two preceding winters was due, of course, to the drought in the summer and autumn of 1930, as a result of which the vegetation depleted the soil moisture to an unusual extent, and to the fact that precipitation during the winter was subnormal. All the water from the meager rains and snows of last winter that seeped into the soil was required to restore the moisture supply of the soil. Near the end of March the soil had received nearly all the moisture that could be stored in it and contained a fairly satisfactory supply for the spring needs of the pastures, trees, and crops. It was obvious, however, that unless there were heavy and prolonged rains in the last part of March or during April or the early part of May, before the vegetation would begin to make heavy demands on the soil moisture, there would be little prospect of obtaining substantial replenishment until the winter of 1931-32. Failure of replenishment during the early spring would in all probability result in depressing the water table to new low stages in the summer and autumn of 1931 which in turn would cause the failure of additional shallow wells and the further dwindling of the flow of springs and streams. The heavy rains this spring produced the above-mentioned rise of about 6 inches in the period beginning March 28. This is only a small part of the needed recovery, but it is very encouraging in showing that the soil storage in the vicinity of the observation well has been completed and that replenishment of the ground-water supply has begun. Heavy and prolonged rains continuing through June would be very beneficial in restoring the water supply of the wells and springs of this section of the country.

The observation well near Washington of course shows in detail only the conditions in the vicinity of the well, but nevertheless it has general significance for the entire region that has been afflicted with subnormal precipitation during the last year.

As a rule the deeper drilled wells are not seriously affected by droughts, because they extend to considerable depths below the water table and draw their supplies from underground reservoirs of great holdover capacity. The shallow dug wells, however, extend only slightly below the normal position of the water table, and hence many of them go dry or nearly dry when the water table descends to an exceptionally low stage. Springs receive only the overflow of the great underground reservoirs, and hence they are very sensitive to fluctuations in the water table caused by seasonal differences in precipitation. Streams depend on the springs for their flow except in times of storm run-off, and they are therefore also sensitive to fluctuations in the water table.

Increased Cost of Water Main Extensions

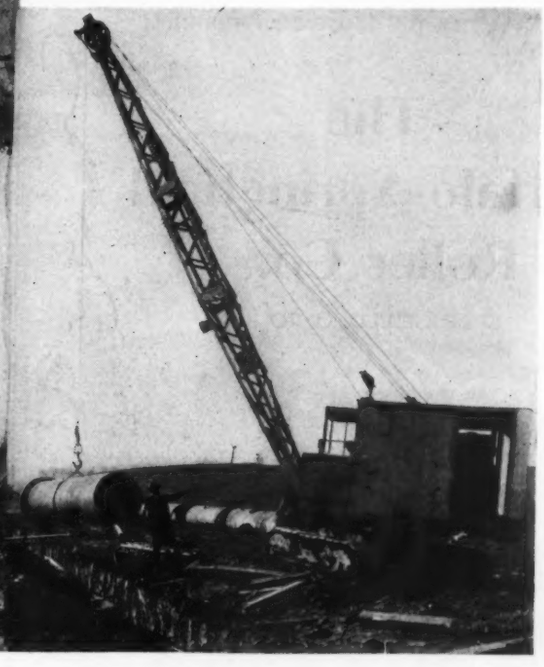
The Columbus, Ohio, Division of Water classifies the cost of making extensions of its main lines under the headings: Wages of employees, Pipe, Special castings, Lead and hemp, Valves, and Other expenses. Accounts so classified for the past 19 years, totaling $3,547,988, give the following average percentage of the total under each of these heads: Wages, 42.4 percent; pipe, 38.7 percent; special castings, 3.3 percent; lead and hemp, 2.5 percent; valves, 3.9 percent; other expenses, 9.2 percent.

In 1912, when more of this work was done than in any year prior to 1922, wages received 38.7 percent of the total, omitting "other expenses;" pipe cost 50.9 percent, special castings 3.5 percent; lead and hemp, 4.1 percent; valves, 2.8 percent; other expenses 3.6 percent. In 1930, when more was done than in any previous year, wages totaled 50.5 percent; pipe, 38.5 percent; special castings, 4.3 percent; lead and hemp, 2.6 percent; valves, 4.1 percent.

This indicates that labor now receives a thirty percent larger share of the total cost than it did nineteen years ago and cast iron pipe 24 percent less. If we compare these on the basis of length of mains laid (we do not have the tonnage laid available), we find labor received 77 cents a foot in 1912 and $2.01 last year; and pipe $1.01 and $1.53 respectively; an increase of 161 percent and 51 percent respectively.

Power Shovels Prove Useful and Economical in Pipe Handling and Laying

Upper left, a Link-Belt gas crane trenching and laying water main in Indianapolis. Above right, a Universal crane handling concrete pipe. Left center, a General trenches and also lays cast iron pipe in St. Paul. Left, below, a Bay City tractor shovel excavating close to a high tension line. Right, below, a Bucyrus-Erie handling large cast iron pipe. Note the few workmen in all these pictures.



Principles of Design of Steel Highway Bridges

(Continued from the May issue, page 90)

The type of steel superstructures most adaptable to Indiana's county roads are the plate girder, the rolled beam, the pony or low truss and the high or through truss.

For ordinary Indiana conditions, the plate girder is seldom economical for spans of less than 75 or 80 feet unless the girders are encased in concrete. Cover plates on the flanges are usually not necessary for a length of between 60 and 80 feet, but it is desirable to use such plates to protect the tops of the girders from the elements. Plate girders shipped in a single piece are difficult to handle in loading and unloading with as small a crew as can handle some other type of superstructure very easily; it is seldom that a crane of sufficient load capacity to handle and set a plate girder is found on a country job and it is usually necessary to erect bulk work and roll the girder into its position.

The use of wide-flange rolled beams, sometimes called girder beams, is increasing. Such spans do not take much more headroom than the better designs of trusses and plate girders, the erection costs are low, they lend themselves to architectural treatment, the fabrication costs are much lower than those of plate girders or trusses, and the maintenance costs should not be as much as those of the former two types. "Other things being equal, we can design a span today using rolled beams with concrete floor slabs for less money than the truss or plate girder, providing the span does not exceed 60 feet and that the roadway width is 24 feet or over. We are also designing rolled beam spans with concrete floor slabs which are cheaper than rolled beam spans with wood sub-floors and a wood block or plank wearing course, provided that the span length is around 30 feet or more.

"When the span length for a rolled beam bridge is about 36 to 40 feet, it is well to introduce diaphragms in the nature of standard section I-beams at the third points of the span to add rigidity to the deck. If all of the beams are encased in concrete, these diaphragms may be omitted. Form work for a concrete encasement of steel beams does not require any false work as the forms can be suspended by pencil rods passed over the top flanges and threaded at the ends to receive washers and nuts, the rods passing through holes in the form work. If an architectural treatment of the fascia girders is desired, paneling may be introduced in the form work. When the steel is encased in concrete it does not require any paint." Where it is so encased, the concrete should be figured in the dead load of the bridge. An 18-inch beam with a 7½-inch flange spanning a length of 30 feet will require an increase in its section modulus of about 18 per cent to carry the additional load required by encasing it with concrete of a rectangular cross section larger than the beam at all points by 2 inches at least. Likewise a 36-inch beam with a 12-inch flange will require an increase in its section modulus of about 35 percent for a similar encasement.

The use of a pony truss generally will save the county money in spans of over thirty feet when a wooden floor and narrow roadway are used, and is economical in spans of over 60 feet and up to about

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Jacking a Storm Sewer Under a Busy Street In Nashville

By Felix Beazley

Construction Engineer, City of Nashville, Tennessee

IN March of this year thousands of Nashville citizens using 8th Avenue sped by Drexel Place, little realizing that the old stone culvert under 8th Avenue, a link in a 42-inch storm and sanitary sewer, was being replaced by a new type of structure. By the use of the latest approved methods, the new sewer was installed under the very pavement over which they were traveling not only without interfering with traffic but also at a substantial decrease in construction costs.

This replacement was one of the outstanding problems facing the city engineers when it was decided to widen and recondition 8th Avenue, south of Broad street. The stone culvert was under 8th Avenue only, the sewer being brick in each direction from the street.

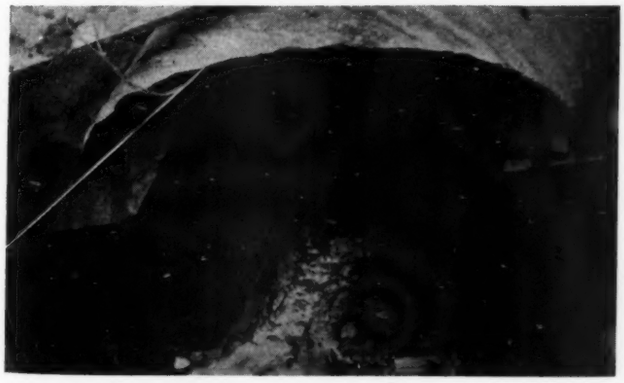
The sewer, which runs from west to east, comes into 8th Avenue on a skew, as shown in the plan. It then continues as a 6-foot stone culvert which ran parallel to the street for about fifty feet, made a right angle turn across the street and continued as a 45-inch brick sewer. This old stone culvert was efficient years ago when it was made a link of the sewer, but the storm water interception above this point has been increased since that time and, because of the abrupt turns in the sewer at this point, it was unable to take care of the water during big rainstorms. As a result, the streets above that point were flooded after every heavy rain.

To relieve this condition it was decided to replace the stone culvert by extending the 42-inch brick sewer under the street on practically the same line that it came to the street—the new location being along the third side of the triangle formed by the stone culvert and the new section.

In deciding the method of construction the city engineering department had to consider the following facts:

The traffic on 8th Avenue includes regular city traffic, inter-city traffic, and double-track trolley service. The work had to be done right at the intersection and no convenient detour could be made because of a railroad underpass one-half block south. All of the work had to be done between the curb lines, and it was impossible to make definite borings because of the debris in the fill under the street. The flow line was 13 feet below the surface.

Ordinarily a trench would have been dug across the street, the storm sewer laid in the bottom, the trench backfilled and the pavement restored. This method, however, would have necessitated falsework to take care of the two car tracks and traffic, the 36-



Above: Looking north on Eighth avenue. Jacking pit under right hand track at low spot. Two lines of traffic passing over the job. Below: Brick invert at junction of corrugated pipe with old sewer

The boy and paving breaker who removed the ledge of solid rock and the loose rock.

Left: Front end of pipe coming through old stone wall. Note slab over old culvert.

Clay filled cement bags were placed in front of the pipe to prevent sewage from going through it.

inch water main (with pressure head of 90 pounds per square inch), and all the service lines (definite locations unknown) that might have been encountered.

As the public in this case would be directly affected by the choice of the method of placing the sewer, an effort was made to find a way that would provide the greatest convenience and safety. Two types of construction were considered, the use of the open trench, mentioned above, and the Armco jacking method. After a careful study of the two methods, the city engineer, W. W. Southgate, and the writer, who was in charge of the construction work, decided to use the Armco jacking method and to do the work with city forces. Use of this method would not only eliminate the necessity for a detour and the dangers of open excavation, but would (as subsequent results proved) greatly lower the ultimate cost.

The type of structure to be installed and the materials of which it should be made were given equally careful consideration, and 52-inch (special diameter) 10-gauge Armco corrugated pipe was selected. Paved invert pipe was not used in this instance, as we intended to line the new structure with a single ring of brick to make it match up with the remainder of the old sewer, of which it was to become a part. The 42-inch brick sewer connecting up with the new structure on either side of 8th Avenue was in good condition.

The Jacking Operation

As it was necessary to work within the curb limits and the flow line of the sewer was 13 feet below the street, operations started with the opening of a shoring pit at the downstream end of the location selected for the new link in the system. It was necessary to extend the pit under one car track, but a 12 by 12-inch pine stringer took care of this without trouble. The pit was made large enough and with sufficient depth so that a 10-foot section of corrugated pipe could be placed on the two guide timbers at the flow line, and on proper grade.

The guide timbers were set to exact line and grade, and a backstop erected at the back of the pit. With a 10-foot section of pipe in place and a suitable bearing frame giving equal pressure on the entire open end, the culvert was shoved forward by two parallel 25-ton jacks, placed in a horizontal position.

The line and grade necessary to bring the pipe into a junction with the old brick sewer had of course been calculated and the guide rails in the trench were set accurately to keep the pipe on the correct line and grade.

In jacking the pipe through, all material encountered was clay, except in the last 12 feet where both solid and loose rock were found. The solid rock projected into about a third of the area of the pipe, while the remainder was stone fragment and the wall of the old stone culvert. A pneumatic air spade was used on the clay and a pneumatic paving breaker on the rock. The opening, made just the size of the pipe, was kept from one to fifteen inches ahead of it. The spoil was brought in lifts to the platform by hand shovels. The pipe was jacked forward as the work of excavating progressed.

After one section of pipe had been jacked into place, another was lowered into the pit and a connection made by field riveting. This process was continued until 32 feet had been jacked into place. The two remaining sections, an 8 and a 10-foot, were placed in the pit and connected with 12-inch connecting bands, making the new structure 50 feet long over all.

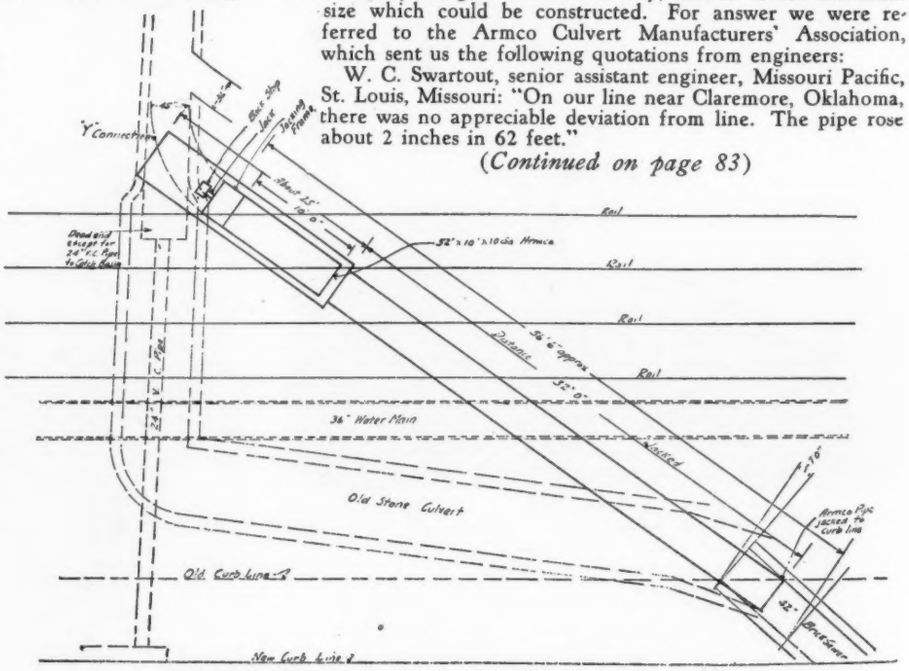
The pipe met the brick sewer in almost perfect line, but approximately 3½ inches below the uniform grade. As there was a drop of 30 inches in the total length of new sewer, it seemed better to have the upper end too low rather than too high, and great precision did not seem necessary so long as this was secured. After the brick lining had been laid the sag was hardly noticeable.

By using this jacking method, two lines of traffic were kept moving on the street at all times. The 36-inch water main and other service lines were not disturbed and all risks in this connection avoided. It was necessary to build falsework under only one car track and the construction work was done at a very marked saving. The 8th Avenue installation, a pioneering project as far as jacking of municipal pipe in this city was concerned, was a source of gratification, both from the standpoint of economy and speed. It solved the problems of this difficult replacement for Nashville's engineers.

In reading the above article the question was raised in our mind as to the accuracy in line and grade reasonably obtainable in jacking sewers in this way; also as to the minimum size which could be constructed. For answer we were referred to the Armco Culvert Manufacturers' Association, which sent us the following quotations from engineers:

W. C. Swartout, senior assistant engineer, Missouri Pacific, St. Louis, Missouri: "On our line near Claremore, Oklahoma, there was no appreciable deviation from line. The pipe rose about 2 inches in 62 feet."

(Continued on page 83)



General plan, showing location of new and old sewers

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How Much Superelevation at Curves?

By D. Y. Bate

Junior Civil Engineer, Street Design Division, California Dept. of Public Works

THE desired effect of superelevation has been described by C. H. Purcell, state highway engineer of California, as follows:*

"Superelevation must provide safety without limiting operating speeds.

"It should provide, at any given speed, uniform effect on the vehicle regardless of the radius of curve.

"The superelevation transition between tangent and curve and between different types of curvature (reversing curves, etc.) should provide easy, natural riding, should avoid pitching, especially on steep grades, and should be as short as possible while meeting these conditions."

There is a certain amount of psychology in curves, and when properly handled the driver loses his fear.

In the September issue of PUBLIC WORKS, under the heading "Economics of Highway Design," was a transcript of a lecture given at Yale University, July 18, 1930, by A. G. Bruce, senior highway engineer, Bureau of Public Roads. The conclusion of this article was being awaited pending the arrival of the October issue, when an article appeared in the "Engineering News-Record" of October 2, 1930, which advocated a limit of 20% superelevation. Mr. Bruce was communicated with and replied in part as follows:

The formula E equals .067 $\frac{V^2}{R}$, was accepted by the American Association of State Highway Officials after quite careful study of the question of curve superelevation. It is intended for average conditions as they exist in the majority of States and takes into account the winter conditions existing in States where snow and ice in varying amounts prevail.

"If you do not have snow and ice to contend with, we believe you are fully justified in the use of superelevation .125 per foot of width." (Equivalent to 12½%).

On the quarter line of an ordinary street crown we have a 7% cross-grade, which results in no discomfort. On this assumption we developed two formulae, one for comfortable speed and one for the maximum speed that is safe with a maximum allowable superelevation of 12.5%. The formula for comfortable speed is, E plus .07 equals .067 $\frac{V^2}{R}$, and for maximum safe speed E plus .25 equals .067 $\frac{V^2}{R}$

To corroborate these formulae, a number of curves were tabulated for both speeds and enough of the men in the office were interested so that, by their trying out these curves in their own cars, we obtained a fair cross-section of the driving public.

A great deal of the calucuations in the above formulae were made by E. W. Merwin, assistant engineer.

The accompanying graphs show these formulae worked out for different speeds and radii.

The California State Highway Department last year changed its standard for superelevation, graphs of which are shown herewith.

C. C. Wiley, recommends a minimum superelevation of E equal .03 $\frac{V^2}{R}$, with the run-off from maximum superelevation in 100 to 150 feet for normal speeds and 200 to 250 feet for higher speeds.

T. R. Agg, in "Construction of Roads and Pavements" states as follows:

"The theoretical superelevation for any horizontal curve, when no account is taken of friction, may be calculated by assuming that F_1 (the centrifugal force in pounds) and F_2 (W tan Θ) are to be equal: hence there is no tendency for the vehicle to slide in either direction.

Then tan Θ equals $\frac{V^2}{gR}$ equals .067 $\frac{V^2}{R}$.

The effect of friction between tire and road surface may be introduced as follows:

Let p equal the percentage of the weight that is carried by the rear wheels of the vehicles,

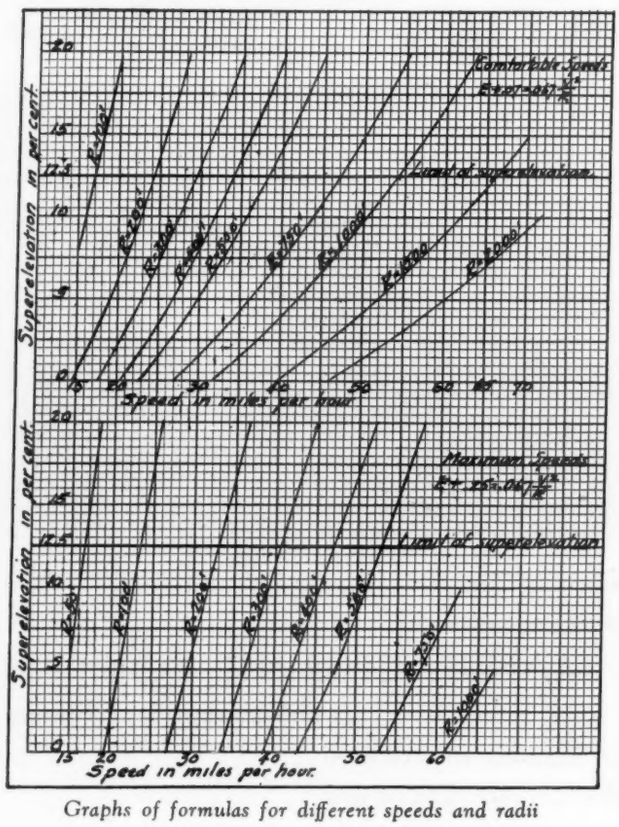
f equal the coefficient of friction between tire and road surface; then,

W tan Θ equals $\frac{WV^2}{gR}$ -pWf; and tan Θ equals .067 $\frac{V^2}{R}$ -pf.

"This equation is convenient for estimating the conditions that will exist on a curve that has less than the theoretical superelevation and is low resistance because of ice or some other coating on the surface of the road."

Superelevation is a large subject, of which the writer lays no claim to being master, merely passing on what information he has obtained with the idea of helping others.

*Engineering News-Record for January 1, 1931.



Graphs of formulas for different speeds and radii

On October 29, 1929, the state highway department adopted rules for curve superelevation, a general idea of which may be obtained from the curves. In addition to these, there are diagrams for reversing unwidened curves with intervening tangent less than 150 feet; the same with tangent from 150 to 300 feet; for compound curves; and for curves in the same direction with intervening tangent.

These regulations provided that all curves of 10,000 ft.

(Continued on page 66)

Radius	Superelevation in Feet per Foot of Roadbed Width
200	.128
300	.128
400	.128
500	.120
600	.112
700	.104
800	.096
900	.088
1000	.080
1100	.072
1200	.064
1300	.056
1400	.048
1500	.040
1600	.032
1700	.024
1800	.016

TABLE 1

Superelevation for Curves of Radius greater than 1800 feet will be:

0.008′ per foot of width for roads paved with Portland Cement Concrete

0.012′ per foot of width for all other types of surface and for unsurfaced roads.

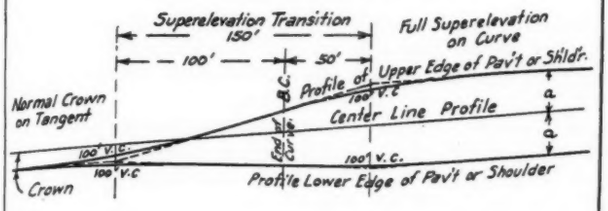
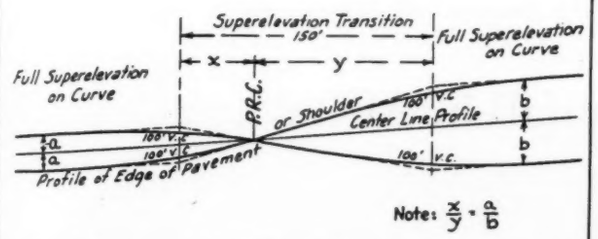


Fig. A
Simple Curve With Unlimited Tangent Approach

Fig. B

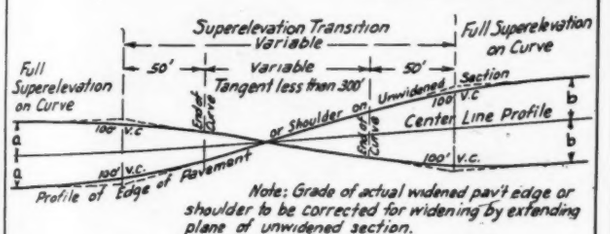


Note: $\frac{x}{y} = \frac{a}{b}$

True Reversing Curves With No Intervening Tangent

Fig. C

Note: When intervening tangent is less than 50' apply superelevation as in Case D.



Note: Grade of actual widened pav't edge or shoulder to be corrected for widening by extending plane of unwidened section.

Reversing Widened Curves With Intervening Tangent Less Than 300 Feet.

Saving by Using Bulk Cement in Road Work

ACCORDING to figures obtained by a survey made in December, 1930, by the C. S. Johnson Company, bulk cement was being used in all state road work in Minnesota and Iowa; in 75 percent of such work in Nebraska, Oklahoma and Wisconsin; 20 percent in Kansas, 10 percent in Ohio, 5 percent in Illinois, 2 percent in Indiana and 1 percent in Pennsylvania.

Referring to the uses of bulk cement, K. H. Melzer of that company makes the following statement: It is the general rule that bulk cement can be purchased at ten cents a barrel less than sack cement. This means a saving in purchase price alone of $300 per mile in highway work where the pavement is 18 feet wide and an average of 7 inches deep.

Many contractors are afraid of demurrage in connection with bulk cement, but an investigation of the regulations in regard to demurrage indicates that no contractor using good judgment need get into trouble. As a rule railroads classify bulk cement as a perishable product that cannot be unloaded in rainy weather, and the time of demurrage does not start during such weather. Furthermore, the time of demurrage starts from the first 7 A. M. after the car is received, and the 48 hours following this are free from demurrage charges. Then there are four days at $2 per day, and any additional days are charged at $5 per day. In the case of a car holding 300 barrels of bulk cement, there is a saving of $30 in the cost of this cement. On the above demurrage rules, this car can be held for ten days at a demurrage charge of $28 and, Sundays being free, it can really be held eleven actual days at this charge. It follows that no careful contractor need get into serious trouble on account of demurrage charges provided he is watching his business and controlling his shipments.

Two contractors have stated that the total saving effected by bulk cement is all the profit that they ask on a job. This seems quite an extreme statement but no doubt there are, conservatively speaking, possibilities up to 5 percent of the cost of concrete.

Bulk cement can be handled with equal or less labor than sack cement. There is also a saving in the expense of handling, cleaning and preparing sacks for return shipment, and a saving due to the elimination of the lost sack factor, which may amount to as high as $10 per day.

Above all, there is a very important potential saving that may be realized by proportioning the batches so that each batch is the maximum quantity of concrete the mixer is allowed to mix. In some cases this may be, say 675 pounds of cement per batch. If sacks are used, the batch must be proportioned or six sacks or else the balance weighed out. As a general rule, bulk cement enables the contractor to increase the size of his batches 5 percent or more. Of course, the number of truck trips is reduced due to the larger batches, and the yardage per batch and per day from the mixer is increased unless other things interfere.

These factors should result in 5 percent or more pavement with the same labor charges against the concrete, hauling and material handling.

Handling Bulk Cement

The equipment offered for handling bulk cement indicates three general methods of handling—by hand cart, bin and bucket elevator, and bin and pneumatic pump.

Cart System.—Some contractors equip themselves with three to six hand carts and a platform scale. They then build a platform level with the car door and a branch platform leading from this and drive their trucks under the branch platform. The carts are run into the railroad cars, filled by shovel with approximately the right amount of cement, and run outside onto a platform scale where cement is either added or removed to obtain the batch weight. In a short time the operator becomes so experienced that only a part of a shovelfull need be added or subtracted on the scales. Then the carts are run onto the branch platform and dumped into the trucks.

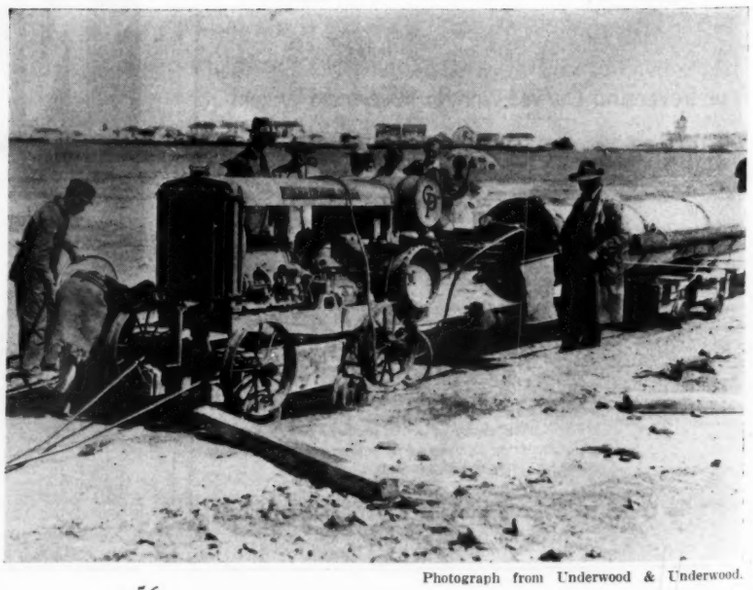
(Continued on page 84)

Laying a Sewer Outfall in Africa

The accompanying illustration shows some of the equipment connected with the launching of an 1,800-foot steel outfall line for the discharge of sewage into the ocean at Green Point, Cape Town, Africa. A CP portable air compressor was used for pumping air into the pipe line. A pressure was maintained of 10 pounds per square inch in addition to the 14 pounds absolute pressure. The pipe was divided into nineteen sections, connected with ball and socket joints; the longest section being 127 feet long and the shortest 50 feet.

Before the pipe could be launched it was necessary to wait for favorable tide conditions, which occur only at infrequent intervals.

The illustration shows the pipe, the carriage carrying it and the truck on which the carriage is mounted.



Photograph from Underwood & Underwood.

The South Greensboro Sewage Treatment Plant

(Continued from page 26)

steel cans, placed beneath the operating floor around the grit chambers, and removed by means of an electric hoist and runway.

Pumping Station Wet Well—The wet well has a capacity of approximately 37,000 gallons with a minimum water depth of 1.3 feet at the grit chambers and a maximum water depth of 7.2 feet at the pump suctions. The roof of the wet well is of concrete slab and beam construction and serves also an operating platform around the grit chambers. Access to the wet well is by means of manhole openings through the roof.

Pumping Station—The pumping station is 25 feet by 37 feet in plan. The heating plant, sewage and sludge pumps, suction, discharge piping and pump control float chamber are located in the substructure of the pumping station, which is of concrete construction. The superstructure is of brick masonry with concrete copings, steel sash and doors, with roof supported on steel beams. The operating floor is at grade level, access to the basement being by a steel spiral stairway. The sewage pump motors, crane, switching and pump control panels, office and wash room are located on the operating floor.

Sewage Pumping Station Equipment—The pumping equipment consists of two variable-speed pumps of 0.5—2.5 m.g.d. capacity each, and two constant-speed pumps of 2.0 m.g.d. capacity each, with a discharge head of 29 feet. The pumps are of the vertical type, manufactured by Yeoman Brothers, direct connected to 220-volt 3-phase, vertical Westinghouse motors. The maximum flow for which the treatment plant is designed will necessitate the use of one variable-speed and two constant-speed pumps, one variable-speed pump on any occasion being held in reserve as a standby unit.

The rate of pumping is controlled by the rate of flow of the incoming sewage to the wet well, through a float-actuated pump control. The pumps discharge through a 30-inch cast-iron discharge line 800 feet long into the primary sedimentation tanks. A venturi tube in the discharge line and a Builders Iron Foundry Company, Type "Y" recording instrument, records, totals and indicates the pump discharge.

Motors, switchboard and motor control.

Sewage Pump Control Equipment — The sewage pump motor control equipment is an integral part of a seven panel switchboard for the control of all electrical and lighting equipment of the plant and is of Westinghouse design and construction. An incoming line panel with master circuit breaker, volt meter, ammeter and wattmeter is provided, together with a power and light distributing panel enabling control, through knife switches, of eight individual circuits. Two panels are mounted with push button controls and protective equipment for the operation of the grit chamber, sedimentation tanks, and coarse bar screen mechanism and a sludge pump.

The sewage pump motor control panels are designed to vary automatically the pumping rate of the variable-speed pumps to correspond to the fluctuation of the sewage flow, through a master switch actuated by a float, with manual control of the constant-speed pumps through push buttons and contactors for full voltage starting.

Pumping is started by putting one of the variable-speed pumps into service. Its speed is automatically increased proportionate to the increase in flow, and when its capacity at maxiumm speed is exceeded, an alarm bell and pilot lights notify the operator to start a constant-speed pump, when the variable-speed pump will automatically have its speed reduced to correspond to its minimum capacity. Should the flow continue to increase and exceed the maximum capacity of one constant-speed and the one variable-speed pump, the operator is again signalled to start up a second constant-speed pump, thereby again reducing automatically the speed of the variable-speed pump to its minimum capacity. Should a continued increase of the flow bring the second constant-speed pump to its maximum capacity, any further increase in flow is bypassed at the control chamber. Decrease in sewage flow will produce a proportionate decrease in rate of pumping.

Grit chambers and bypass channels. Right, grit collection buckets.

(To be continued)

Activated Carbon Removes Tastes and Odors

(Continued from page 20)

that less carbon would be required at this point than when added to the raw water. The results at New Castle have shown this to be true. An effluent water free from taste and odor has been obtained through the use of .15 grain per gallon of carbon. In adding the carbon to the water passing to the filters, it is necessary for the particles to be thoroughly distributed through the water before it reaches the filter. The carbon used in the experiments at New Castle has been pulverized so that practically 100 per cent passes a 200-mesh sieve. There is a limit to the quantity of carbon that can be applied to the filters without reducing the length of filter runs between washing, but there has been no appreciable effect upon the filter operation by the treatment used at New Castle.

Activated carbons are costly. For this reason, it will be necessary to obtain the desired results with relatively small quantities of carbon if the treatment is to be considered a practical one and become widely used in water works practice for the removal of tastes and odors. From the experience obtained so far in removing several types of odors and tastes successfully, the possibilities of the treatment look very promising.

Chicago's Water Works a Half Century Ago

(Continued from page 30)

pumps are 57 inches in diameter, stroke 10 feet. The working beams are each 28 feet long and weighs 20 tons. The fly wheel is 26 feet in diameter and weighs 40 tons.

"The first engine was erected at these works in 1853. It had a capacity of 7,500,000 gallons in twenty-four hours. The second engine, erected in 1857, had a capacity of 13,000,000 gallons in twenty-four hours, and the third had a capacity of 18,000,000 gallons daily. The first and second engines were single, the third and fourth double. These engines are supplied with steam from five boilers 12 feet in diameter and 20 feet long.

"In 1871 Chicago had 271 miles of pipe, now it has 500 miles, and it has over 3,000 fire hydrants. This extensive system of water supply has been perfected at an expense of about $8,000,000.

Bituminous Surface Treatment at Low Cost

(Continued from page 23)

application, a truck scraper was used to mix and windrow the material from centre to sides and back again. The entire mixing operation required three applications, or approximately 1½ gals. per sq. yd. The final application of ½ gal. was covered with stone chips, and broom dragged and rolled until smooth and compacted. Recent section tests show not less than 2½" thickness, and in some cases as much as 4".

The costs per mile and per square yard for the above treatments, including material, aggregate, distribution, supervision, spreading, rolling, etc., are as follows:

	p. m.	p. s. y.
Asphalt on sand (mixed-in-place)	$1679.14	0.18
Re-treatments (cut-back asphalt)	774.92	0.082
Re-treatments (hot tar)	1010.77	0.108
New treatments on sand-clay (cut-back asphalt prime & seal)	1315.84	0.14

Refuse Disposal in England

A PAPER dealing with the collection and disposal of refuse was read on March 20th before the Royal Sanitary Institute, England, by S. C. Baggott, city engineer of Lincoln, in which he gave facts and figures pertaining to Lincoln's experiences, and opinions which he had formed from these and his inspection of such work in other cities.

Lincoln uses 3 electric trucks, one gasoline truck, one gasoline tractor with 3 horse-drawn trailers, 4 low-loading horse-drawn vehicles and several other high-loading ones. The mixed refuse is hauled to a destructor which is located at the outlet of the sewerage system, where it pumps the sewage to a treatment plant continuously.

The cost of collecting 15,720 tons from 17,596 houses last year was $38,834, or $2.47 a ton; collection being made weekly from residences and semi-weekly from large hotels. The cost by electric trucks was $2.58; by gasoline truck, $2.31; by tractor and trailers, $2.06; and by low-loading horse vehicles, $2.66. It is estimated that the long haul to the treatment works accounts for 36 cents a ton, which should be credited to the collection and debited to the sewage plant. The electric vehicles have been in constant use for eleven years and are still "giving an average running efficiency of 95 per cent"; due, in Mr. Baggott's opinion, to the comparative freedom from vibration and strain of this type of vehicle.

Concerning disposal, Mr. Baggott says that dumping is the most economical method when dump sites are convenient, and that dumps can be kept sanitary by using sufficient suitable covering material; but that too often they are *not* sanitary.

Salvage and utilization can be proved to be the cheapest method by certain combinations of figures, while figures from the same source can be used to prove the exact opposite. The writer questioned whether there are many places where this method has really been economical; but whether or not, "The sorting of all classes of refuse after delivery to the disposal works and redistribution throughout the country of the filthy and disease-laden constituents of such refuse is undoubtedly a wrong policy. I am aware, of course, that some authorities make some pretense at cleaning the various types of rags, woolens, papers, etc., but if this is to be done in a thorough manner it can only be done by sterilization or thorough disinfection, and the cost of such process would be entirely prohibitive.

"My experience of the disposal of salvaged constituents, such as bags, rags, woolen, papers, bones, glass jars, non-ferrous metals, cinders and baled tins, has been anything but satisfactory; while at certain periods reasonable prices can be obtained which justify the salvage, at other times the market is difficult and even impossible, which makes it incumbent upon the authorities to provide storage and wait for the market. For instance, the following are the prices for the various constituents in early 1930, as compared with the present time:—

	1930	PRESENT PRICE
Baled tins	36s. 6d. per ton ..	23s. 6d. per ton
Non-ferrous metals	15s. 0d. per cwt. ..	6s. 6d. per cwt.
Glass jars	3d. per doz. ..	No sales.

(Continued on page 66)

Free Water and Water Bills

THERE is pretty general agreement among water works men that it is desirable that the water department's finances be kept separate from those of the other municipal departments or of the municipality as a whole; also that the department receive payment for all water furnished, including that for other departments and municipal purposes, and on the other hand pay from its income all interest, sinking fund and other overhead charges.

The separation of water department finances from all others has been becoming increasingly general during the past decade or two; how general, however, we did not know, nor did there seem to be any definite information on the subject. Accordingly, we included questions on this subject in a questionnaire sent last month to officials of practically all the water works in the country. A synopsis of the replies is given below.

Replies giving definite information on these questions had been received from 264 municipal water departments when we began this analysis. (The total number of questionnaires greatly exceeds this. A number did not give definite replies to this question; no private plants were included, and other questionnaires have continued to come in.)

Of those replying, 90 percent report that their finances are kept separate, except that in three cases water works and lighting are combined in one department. Only 25 reported that they were not thus independent financially. Of these 25, 7 were in the New England states, 7 in the South Atlantic, 3 in the West North Central, 2 each in the East North Central and East South Central, and 1 each in the Middle Atlantic, West South Central, Mountain and Pacific districts. Considering the number reporting, we find that the percentage of all cities so reporting is almost exactly the same for the country west of the Mississippi as for that east thereof.

Free Water

Considering the amount of free water furnished the reports are not so satisfactory. About 56 percent of the cities furnish more or less free water for municipal purposes, and 20 percent for hospitals, churches and other public but non-municipal purposes. Only 42 percent are paid for all water furnished; but we confess pleased surprise that the number is this large.

Of those furnishing free water, 50 percent report that the value of this at commercial rates amounts to 10 percent or less of their income, and 50 percent that it is more than this. There are some extreme cases. One New York department reports that if it were paid at commercial rates for all the water it furnishes free its income would be increased 200 percent; one reports 45 percent, three 40 percent, eight about 35 percent. Among the uses of this free water are mentioned schools, public buildings, fountains, cemeteries, parks, hospitals, churches, flushing streets and sewers.

Considering the cities by districts, we find that no free water is furnished by 44 percent of the New England departments, 26 percent of the Middle Atlantic, 20 percent of the South Atlantic; 37 percent of the East North Central; 18 percent of the East South Central; 23 percent of the West North Central, 12 percent of the West South Central; 20 percent of the Mountain, and 30 percent of the Pacific. It will be noticed that in each pair of north and south districts approximately twice as large a percentage is paid for all water in the north as in the south. Not only this, but the percentages of free water are greater in the south. Considering the three districts of the Atlantic seaboard, the departments which furnish free water valued at more than 10 percent of their income constitute 22 percent of the New England states, 24 percent of the Middle Atlantic and 28 percent of the South Atlantic. Also 20 percent of the East North Central, and 28 percent of the East South Central; 17 percent of the West North Central but only 12 percent of the West South Central.

Billing and Collecting

How often are water bills submitted? Are they all submitted as of a certain date, or is the work of meter reading, bookkeeping, collecting, etc., spread over the year by rotating the collection dates among the consumers? And what is done when the bills are not paid?

The most common interval between bills is 3 months—51 per cent of the cities report this, while 7 percent more use this period for small consumers and 1 month for large ones. One month for all consumers is reported by 20 percent; 6 months by 15 percent and 4 months by one and 12 months by three. The one month is most popular in the South Atlantic States, where 44 percent use it; the East South Central, 70 percent; and the West South Central, 100 percent. Six months is found chiefly in New England, 40 percent of all so reporting being in that district and including 40 percent of the cities of that district. Quarterly billing is especially general in the Middle Atlantic States, being found in 76 per cent of the cities of that district; also in 65 percent of the cities of the West North Central.

The rotation of billing dates, generally by dividing the consumers into three or more districts, is reported by 26 percent of the departments. It seems to be most popular in the East North Central district, where 39 percent of the departments use it. But its use is reported by some departments in all districts except the Mountain.

Methods of collecting water rates seem to vary chiefly in practice rather than theory. Shutting off the water is the theory in at least 87 percent of the cities; but several use it as a last resort; one has never really used it; some use it as a threat. Many, however, do apparently use it, and several of these require payment of a penalty of some kind before turning on the water—generally $1 or $2, or from 2 to 12 percent of the bill. Several send two or three notices first; some make a personal call. After shutting off, some file a lien on the property for the amount due or have the amount placed on the tax roll.

Quite a number place a lien or report to the assessor and do not shut off the water. One does not worry as he requires deposits from consumers. One in Vermont has no trouble collecting, while a neighbor in the same state makes it a practice to "preach and pray." One Ohio city since January of this year has investigated the ability of delinquents and is patient with those out of work.

State Requirements for the Design of Water Purification Plants

Requirements for design of water purification plants as contained in the regulations of the various state boards of health have been the subject of a recent study by PUBLIC WORKS. In most of the states from which information was secured there are no specific requirements as to design, except that all designs must receive the approval of the state board of health. A few of the states do limit certain features of design, including generally the rate of filtration, the uniformity and effective size of the sand, the depth of the sand bed, the rate of rise of the wash water, the elevation above the sand bed of the lip of the wash water troughs, and the spacing between the troughs.

A statement of "good practice" for water purification plant design issued by the Connecticut State Department of Health, Bureau of Sanitary Engineering, of which W. J. Scott is director, covers so well the general requirements of most of the state boards of health that it is reproduced herewith:

Chlorination Plants—Average dosage, 3 to 8 lbs. of chlorine per million gallons. Residual chlorine maintained, 0.1 to 0.5 p.p.m.

Slow Sand Filters—Rates of dosage 3,000,000 to 8,000000 gallons per acre per day. Effective size of sand, 0.25 to 0.35 m. m Uniformity coefficient, less than 3.0.

Mixing or Reaction Chambers—Detention 20 to 40 minutes. Linear velocity, 1 to 2.5 feet per second.

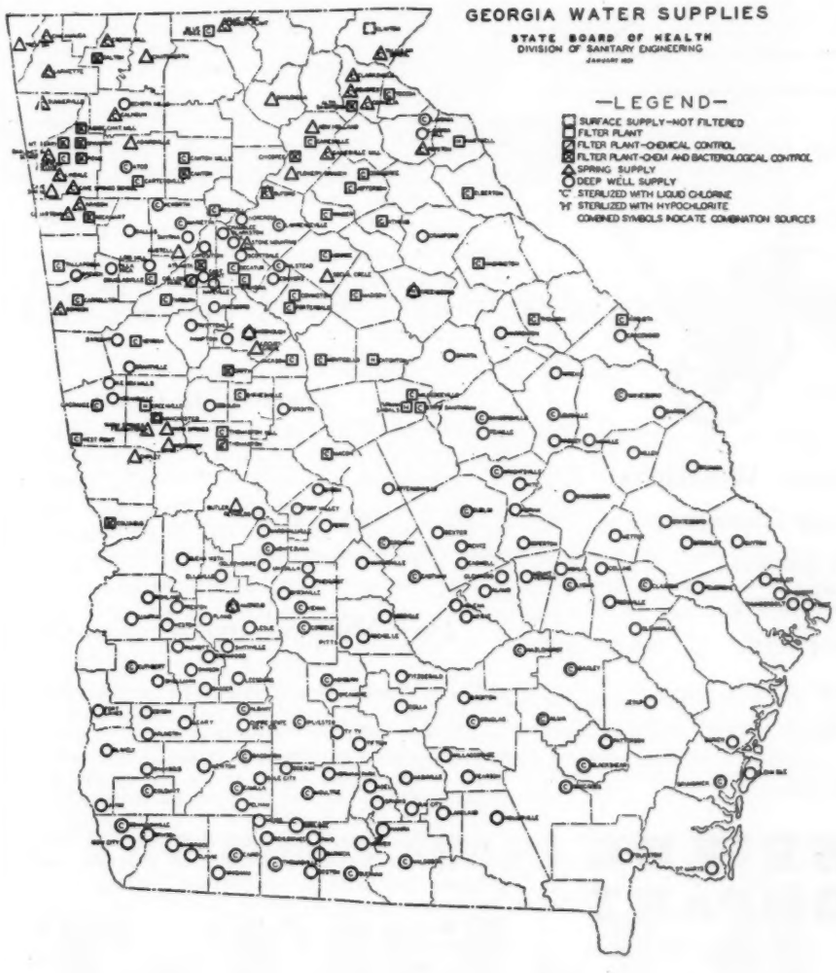
Coagulation Basins—Usual range of coagulant applied, 0.5 to 2.0 grains per gallon. Detention period, 2 to 6 hours. Theoretical velocity not to exceed 2.5 feet per minute.

Rapid Sand Filters—Rates of dosage usually about 125,000,000 gallons per acre per day (2 gallons per square foot per minute). Sand depth, usually 24 to 30 inches. Effective size of sand, 0.35 to 0.50 m.m.; average, 0.45 m.m. Uniformity coefficient not to exceed about 1.7. Free board between sand and top of wash troughs, 20 to 24 inches. Spacing between edges of troughs not to exceed 5 feet. Amount of wash water, about 3 to 5 per cent of total flow. Effecive washing requires vertical wash water rise at rate of at least 12 to 15 inches per minute (7.5 to 10 gallons per square foot). High velocity wash, vertical rise of 20 to 24 inches per minute.

Middletown Markets Its Sludge

The city of Middletown, N. Y., sells the dried sludge produced from the operation of its new sewage treatment works at $1.00 per cubic yard to buyers who do their own loading and hauling, to be used as fertilizer for shrubs, flowers, orchards, lawns, golf courses and gardens, but not on vegetables growing in or on the ground which are eaten uncooked.

The Middletown sewage treatment works were constructed during 1929 and were put into regular operation on January 6, 1930. The works consist of settling tanks, separate sludge digestion tanks and glass-covered sludge drying beds.



Herewith are shown the locations of public water-supplies in the State of Georgia. The symbols indicate the type of supply and the treatment employed. The condition of Georgia water supplies reflects the very able and constructive work that has been carried on during recent years by the Division of Sanitary Engineering of the State Board of Health. L. M. Clarkson is director of the division and W. H. Weir is assistant in charge of water supplies. This work has been based on the instruction and cooperation of local officials and a system whereby samples of water are sent regularly to the State laboratory for testing. These reports form the basis for further work.

The effect of location on source of supply is prominently shown by the entire absence of surface supplies in the southern half of the state, and the predominance of such supplies in the northern half. Only one of the latter is not filtered.

Refuse Disposal in England

(Continued from page 52)

Bones	70s. 0d. per ton	55s. 0d. per ton
Mixed rags	3s. 0d. per cwt.	1s. 7½d. per cwt.
Bagging	35s. 0d. per ton	10s. 0d. per ton
Woolens	20s. 0d. per cwt.	10s. 6d. per cwt.
Old rags and carpets	2s. 0d. per cwt.	1s. 0d. per cwt.

"At Lincoln such salvage as has been attempted has been from a commercial standpoint entirely unsatisfactory.

"*Incineration*—So far as incineration by a destructor properly designed and constructed is concerned, I consider this the ideal form of disposal, as being the most hygienic, sanitary and conclusive form, and, where there is an outlet for the utilization of the steam raised, it is the most economical.

"It has been argued that, with the more extensive use of gas and electricity for cooking and heating purposes, the calorific value of the refuse will be materially reduced as time goes on. I am of opinion, however, that this contingency is somewhat remote, as a number of large authorities have recently installed destructors and have contracted to supply steam to adjoining industrial undertakings.

"The destructor at Lincoln is a typical example of refuse destructors. The original destructor was built in 1913-14 from the designs of Messrs. Heenan and Froude, Limited, of Worcester, and was reconstructed and brought up to date to the design of the writer in 1929 at a cost of £ 9,438. The plant is designed to deal with a maximum of 80 tons of refuse in 16 hours, and the temperature of the combustion chamber is between 1,500 and 2,000 degrees Fahrenheit. A well-burnt, hard clinker is produced, some of which has been successfully used for the making of clinker asphalt for roads and footpaths, etc. The destructor stands at the top for efficiency, as very few destructors are capable of generating sufficient steam from the refuse to pump the sewage and water from a combined system 24 hours per day during the summer.

"The total cost of disposal of refuse for the last twelve months was £ 5,010, which included £ 1,452 loan charges, the cost per ton being 6s. 4½d. Excluding the loan charges, the cost of destruction was 4s. 6½d. per ton."

Paved With Gold

It is reported that a five-mile stretch of road in the southern part of Colorado is paved with concrete, the aggregate for which was crushed from ore dumps of the Cripple Creek gold field, and that the gold in this assayed $1.50 to the ton; which would apparently give more than $3,000 worth of gold per mile.

How Much Superelevation at Curves?

(Continued from page 55)

radius or less be superelevated. "The transverse roadbed on all superelevated curves will be a plane, revolved on an axis coinciding with the ultimate roadbed center line." The transverse slope is given in Table 1. For radii greater than 1800 ft. the superelevation is the rate of the standard crown grade=.008 ft. per foot for portland cement concrete surfaces and .012 ft. for all others.

In the diagram, Fig. A, the superelevation transition length will be 150 feet measured along ultimate center line, extending from a point on tangent 100 feet from the end of curve to a point on curve 50 feet from the end of curve. The edges of the surfacing and the roadbed shoulders will be raised and lowered *relative to the center line* at a uniform rate throughout the transition distance. On widened curves the *relative* grade of the widened pavement edge or shoulder

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must be corrected to allow for the widening and to preserve a plane transverse slope. The breaks in this *relative* grade of pavement edges and shoulders at each end of the transition will be eased by the application of a 100′ vertical curve, which is chosen to simplify the grade calculations.

The other diagrams can be interpreted similarly. Cases B will be avoided if possible, as will the use of compound curves or of curves in the same direction with intervening tangent.

Principles of Design of Steel Highway Bridges

(Continued from page 48)

110 feet where the plate girder does not have the advantage. Fabrication costs for pony trusses usually exceed those of plate girders. Erection requires falsework and can usually be handled by an experienced crew of four men. Pony trusses should have riveted connections and the top chords be braced and stayed by suitable knee braces at the panel points. Maintenance costs generally exceed those of plate girders and rolled beams. The trusses themselves usually provide the means for holding the traffic on the bridge which is generally supplemented by a light channel construction or angles.

A through truss is advisable on spans of 125 feet and over for ordinary construction requirements such as are found in Indiana.

All exposed structural steel should be protected from the weather by at least two coats of good paint, consisting of the red lead shop coat and a good graphite coat.

Cost Comparisons

The following figures have been obtained from an actual design: The clear span required was 80 feet, with a 20-foot clear roadway and one 5-foot sidewalk. The live load was a concentrated 20-ton truck or a uniform load of 100-pounds per square foot. The location required that a structure pleasing to the eye and of low maintenance cost be designed. Using as a basis rolled beams of two spans, each 40-foot clear, a concrete floor and walk, concrete hand rails, encased fascia girders paneled and simulating a flat arch with a springing line, we will take the cost of this, including that of the pier, as unity. This same location spanned by a single pony truss bridge with concrete walk and slab and steel handrail would have cost 1.07 times as much. If a single-span plate girder, with the girders entirely encased in concrete, floor system not encased, had been used, the probable cost of the superstructure would have been represented by 1.40. If the total cost of the rolled beam bridge is taken as unity, then the total cost of the pony truss with its two foundations would be 1.06 and that of the plate girder with its two foundations would be 1.27.

Another cost estimate for a superstructure of 24-foot clear roadway, 30-foot clear span, 20-ton truck loading was made. Assuming the cost of rolled beams, reinforced concrete floor and concrete handrails, none of the beams being encased, as unity, these same conditions can be fulfilled by a pony truss with long leaf yellow pine subfloor of 3-inch creosoted plank, 12-pound treatment, and with a 1-inch asphalt plank wearing surface, for a price of 1.03. The same conditions can be fulfilled by rolled beams, same wood and plank floor, heavy lattice hand rails, for a cost of 1.28. This bridge is located about 125 miles from a creosoting plant, fifty (50) miles from a steel company and within twenty (20) miles of a gravel supply. These costs are for the year of 1930.

to determine which of these may be the sources of tastes and odors upon chlorination. The difficulties which have followed the use of phenol-containing **paints** in standpipes, and basins have led to investigations of painting methods and paints. [19, 104]

Several **water softening** plants are serving Kansas municipalities with success, accordng to R. E. Lawrence. [68, 102] **Ralroad water softening** plants and the benefits derived from their installation have been well discussed by Knowles [28] and Koyl,[27] two veteran railroad water supply engineers. **Foaming** in boilers has been studied in Germany extensively and the results are reported to the French by Selikin [22, 23] More reference to American work would improve the article. Chapman[36] explains the status of **feed water treatment** in Great Britain. Apparently less experience with caustic embrittlement of boilers has been noted there.

Grover[91] briefly evaluates the methods of study of the **water resources** of the United States, as carried out by the U. S. Geological Survey. Atkinson [54] describes the Geological Survey's **current meter** and its action. Other methods of **measuring water** are tabulated by Millard[85] as positive or inferential. Positive methods measure volume and weight. Inferential methods measure current, water level, pressure or velocity and from these data arrive at a value for the amount of water measured. Measuring and **recording instruments** in water plants are urged by W. D. Rolfe,[101] who insists that they make plant operation more certain and more easy.

Operators of water works whose distribution reservoirs have been much frequented by **gulls and other birds,** have been concerned about the matter because the birds increase the Bacterium coli content of the water by their droppings. Birds that feed about sewer outfalls might pick up more dangerous organisms. Legal permission has now been granted in Massachusetts to shoot the birds over reservoirs.[46] The condition of Illinois streams has been responsible for the creation of a **sanitary water board** in that state.[26] Investigations of **rivers pollutions** are being conducted in **Scotland** through the Scottish Advisory Committee on Rivers Pollution Prevention.[92] The sanitation of the water supplies in Minnesota **tourist camps** leaves much to be desired, but rapid progress is being made toward a satisfactory status.[24]

Laboratory

Water ratings for Kansas cities in 1930 have been announced by Mr. Ernest Boyce, the state sanitary engineer.[67] **Bacteriological condition** of these supplies is judged on the basis of the U. S. Treasury Department standard of 1925.[64] Important work on the gas production and increase in the hydrogen ion concentration of cultures of **colon-aerogenes** type organisms has been carried out by Ruchhoft and others[39] in the laboratory of the Chicago Sanitary District. Use of **buffered broths** is recommended in order that the cultures may not become so acid that organisms will be killed and confirmatory tests therefore fail of disclosing the true state of water pollution.

Methods for the **biological examination** of water and their interpretation have been explained by W. C. Purdy, the plankton expert of the U. S. Public Health Service.[58, 59] Attempts to control large numbers of **cyclops** in the raw water of the Monroe, North Carolina water works, have not been successful thus far.[40]

Sulfur dioxide is used in dechlorination of water following super-chlorinaton. Usually it is specified that the liquid sulfur dioxide as supplied shall not contain more than 0.002% of water. The manner of determining the actual amount of water in the liquid is given by Flenner and Caverly.[77] An attempt to evaluate **mineral and boiler analyses** of water on a physical chemistry basis has been made by McKinney.[1] **Mottled teeth** of children who use certain Kansas water supplies is receiving continued attention by the Kansas State Department of Health. The cause is still being sought.[74]

The Drought

The **great drought** of 1930 began in the closing weeks of 1929 and reached its low point during the fall of 1930.[9] **West Virginia** and **Maryland** had the greatest deficiency in rainfall. [96] Streams dried up and great difficulty was experienced in securing any water for some communities. In a number of places water was brought in by tank car for extended periods. **Virginia** suffered also. The Marine Base at Quantico sent 3000 marines home on furlough to reduce the water demand.[12] **Illinois** cities had severe difficulties. Practically the only flow in the Sangamon river at Decatur was the local sewage. Springfield removed and treated the water only 55 miles below.[10] Severe shortage was felt in **New South Wales** in 1929 and in Sydney and suburbs the demand rose from 51.32 to 56.55 Imperial gallons per capita per day.[88] During 1930 the rainfall in the **British Isles** was generally ample. Usually it was greater than normal, but in a few localities sub-normal precipitation was recorded.[82]

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The Drought in New York State

ALTHOUGH not so severe conditions were produced by the drought of 1930 in New York State as in some other states, still many communities were seriously affected and thousands of farm supplies failed.

Both scarcity of supply and use of emergency supplies involved health hazards, and the State Department of Health kept closely in touch with conditions throughout the state. According to a report written a few weeks ago by A. F. Dappert, assistant sanitarian, and C. A. Holmquist, director, Division of Sanitation, "municipalities frequently are driven to extreme measures and it becomes necessary to resort to unsatisfactory or polluted emergency and auxiliary supplies that require effective treatment and careful supervision to prevent outbreaks of waterborne epidemics." In New York, the Division of Sanitation made investigations to locate available emergency sources for many municipalities, directed the installation of emergency hypochlorite plants and maintained the most careful supervision over the emergency sources, with the result that no epidemics occurred in which a public water supply was involved.

The division has collected and compiled data concerning 65 public water supplies which were seriously affected by the drought, varying in size from 170 consumers to 95,652. Of these, 29 derived their supply from surface sources and 36 from ground water. Eight of those that derived their supply from surface sources and one with a ground water supply found it necessary to suspend service to large users or shut off the supply for certain periods.

Of those resorting to emergency supplies, 30 in number, 20 used an emergency surface supply and 12 used an emergency ground water (2 using both); 17 of the surface supplies and 4 of the ground water being given treatment for possible pollution.

Six of the auxiliary supplies—all surface sources—were unsatisfactory in character, and 5 of them were given treatment; and 13—all ground water—were satisfactory, but one of them was treated as a precaution.

Treatment of the emergency supplies was given by emergency hypochlorite plants in ten cases; by regular hypochlorite plants in three; by a fire pump chlorinator in one; by chloride of lime placed in the reservoir in two; by liquid chlorine in twelve (seven of which had used it for their regular supplies); and three which filtered their regular supply filtered the auxiliary one also.

Several interesting expedients were employed in connection with using the emergency supplies. Altamont introduced a chlorinated surface water supply through a fire hydrant. At Cherry Valley, where the supply became exhausted, the residents for a time obtained drinking water from mineral springs.

Gowanda put down another well in 1930, but the yield diminished, and in January, 1931, the static level was 85 feet lower than normal.

At Sharon Springs well water was pumped to different parts of the village at different hours of the day.

Several of the supplies were reduced by leakage in mains or reservoirs, and efforts were made to stop these.

At Gloversville industries were entirely without water for a while, causing a loss estimated at $50,000 a day.

One of these commmunities began use of an emergency supply in June, 1930, but no others until August, when 11 added such supplies, and the following months the additions number 4, 6, 7 and 7 respectively, and 3 were added in January of this year and one in February.

The deficiency in rainfall continued into this year, even increasing in some sections. The maximum total deficiency—9.16 inches—occurred in October in New York City; in December in three of ten representative observation stations, in January in four of them, and in March, 1931 (the latest data available at the time of the report), in two. The maximum deficiency recorded was 10.71 inches total since Jan. 1, 1930, in Albany.

In the opinion of Dappert and Holmquist "The prospects for 1931 do not appear to be good, but it is believed that, because many municipalities have anticipated possible future shortages and have taken steps to increase their supplies, conditions will be relatively better in 1931 than in 1930. If weather conditions should become favorable, the surface supplies of the state will be returned rapidly to a fairly normal condition, but there is some doubt as to how long it will take the sorely depleted ground waters to be restored to normal. On the other hand, if 1931 proves to be a moderately or extremely dry year, as present records indicate may be the case, there is not much doubt but what some additional municipalities that may have been able to survive the 1930 drought will experience some difficulties by reason of the 1930 deficiencies."

Effect of the 1930 Drought on Columbus Water Supply

The normal rainfall for Columbus, Ohio, is 36.34 inches yer year, but in 1930 it was only 21.60, or 40.6 percent below normal. During the fifty-two years that rainfall records have been kept by the local weather bureau no other year has approached this deficiency. The nearest was 27.1 in 1901, and only six other years have shown more than 18 percent deficiency. Moreover, the first two months of 1930 showed an excess of 2.58 inches, so that there was a deficiency of 17.32 inches during the remaining ten months, or nearly 57 percent.

This unusual deficiency in rainfall for the year 1930 started at the beginning of the growing season and continued to the end of the calendar year, creating unprecedented demands for water during the summer months, especially in residential districts due to the use of water for the sprinkling of lawns and gardens.

The unusual nature of the demand during 1930 is shown in the following tabulation, in which is recorded, for the past six years, the number of days in each year when the total daily pumpage in million gallons was equal to or above the indicated volumes.

Days in year when the total daily pumpage was:

Year	30 M.G. or Above	33 M.G. or Above	36 M.G. or Above	39 M.G. or Above	42 M.G. or Above	45 M.G. or Above	48 M.G. or Above
1925.....	43	8	0	0	0	0	0
1926.....	53	16	6	0	0	0	0
1927.....	79	13	3	1	0	0	0
1928.....	157	49	12	0	0	0	0
1929.....	273	101	23	2	0	0	0
1930.....	209	97	62	40	20	5	2

The relation between average daily pumpage and maximum daily pumpage is shown in the following tabulation covering the past six years:

Year	Daily Pumpage in Million Gallons: Average Day	Maximum Day	Per Cent Maximum Day Was of Average Day
1925	26.4	35.1	133
1926	27.7	38.3	138
1927	28.0	39.5	141
1928	29.5	38.9	132
1929	31.2	39.6	127
1930	32.0	49.7	155

The average demand and the maximum demand for water during the hours of the day are shown in the following tabulation which also shows for each hour of the day the percent which the hourly rate is of the average rate.

Hourly Rates of Demand in M. G. D. for Year 1930

	For Average Day	For Maximum Day	Per Cent Hourly Rate for Average Day is of Average Rate
1 A. M.	20.1	25.0	63
2	19.0	25.0	59
3	18.7	25.0	58
4	18.4	24.0	58
5	19.0	25.0	59
6	24.4	38.0	76
7	32.1	48.0	100
8	39.6	59.5	123
9	41.3	60.5	129
10	41.5	61.0	130
11	40.1	56.0	125
12	39.0	56.0	122
1 P. M.	40.2	57.0	125
2	39.1	57.0	122
3	38.2	57.0	119
4	37.5	56.5	117
5	36.5	57.5	114
6	37.3	61.0	116
7	38.0	68.0	118
8	35.1	64.0	110
9	31.9	58.5	100
10	30.3	53.1	95
11	27.6	45.0	86
12	23.4	36.0	73
	32.0	49.7	

Previous to 1925 the city relied on storage created by the Griggs dam, which was supplemented by the O'Shaugnessy dam in 1925, increasing the storage capacity from 1480 million gallons to 6,880 million. During 1930 the loss in stored water was 3,800 million gallons, showing how inadequate the supply would have been had not the latter dam been built.

These facts and figures were given by C. B. Hoover, superintendent, Division of Water and Sewage Disposal, in his annual report.

Mechanical Equipment of Worcester, Mass., Sewer Department

In his annual report for 1930, John H. Brooks, Jr., superintendent of the sewer department, said:

"The natural geological conditions in Worcester do not make for low excavation costs—rock, hardpan and clay predominate. With modern machinery—excavators, air compressors, pneumatic spades, paving breakers and drills—costs have been kept down to reasonable limits. The department's equipment has been in constant operation, which has naturally occasioned depreciation. . . . The department's motor equipment is in excellent condition. A 2½ ton White dump truck has been obtained replacing the Netco which had been in service since 1923.

"The catch basin machines have handled 15,741 cubic yards of material at a cost of $2.16, including the cost of hauling to the dump. There are a total of 5,120 catch basins, all of which have been cleaned at least three times. In troublesome sections more frequent cleaning has been done by means of spare

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equipment. The use of small power dump trucks instead of horse-drawn wagons has proven economical as well as lessening the traffic conditions."

Machine cleaning of catch basins cost a total of $34,083 in 1930, and other cleaning $3,662; and $3,309 was spent in thawing and freeing traps.

Baltimore Limits Acidity of Sewage

The Maryland Bureau of Sanitary Engineering, in reporting upon its studies of the treatment of trade wastes, said in its annual report: "The Baltimore City Bureau of Sewers in consultation with this Bureau has set a pH of 4.0 as a minimum for plant discharge for the protection of its concrete sewers."

Highway Policies in Several States

(Continued from May issue, page 74)

State Aid for City Streets

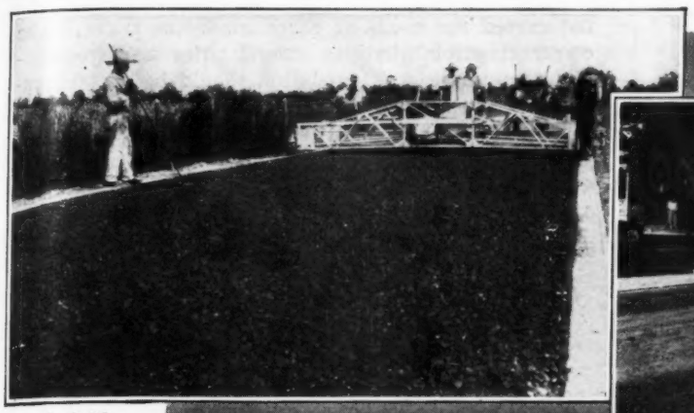
Arkansas.—"Another suggestion is that the State pay the entire cost of paving continuation of State highways through incorporated towns. This would cost more than our highway revenues could stand."

California.—"I expect to ask our highway authorities to co-operate in the construction of roads inside incorporated cities that are logically direct connections and a part of our State system to the extent possible with the funds available under existing law, without jeopardizing the carrying on of the State highway program. * * * Such aid is compulsory in towns under populations of 2,500 and optional above that."

Illinois.—"At the present time there are unfair discriminations between cities and villages in so far as the construction of State routes through them is concerned. Under the provisions of the $60,000,000 Bond Issue Act, the State is not permitted to build through any city or village having a population greater than 2,500 throughout the State at large and 20,000 in Cook County. On the other hand, under the provisions of the $100,000,000 Bond Issue Law, the State can build any of the routes provided for by that act through any city or village in the State except Chicago. In that city, the State is restrained from building because the routes are described as beginning at the Chicago city limits. * * *

"The weakest links in the chain of the State highway system are the streets used as State highways through cities and villages. It is unfair to require residents along the streets used as State highways to reconstruct pavements of the strength and width necessary to carry State-wide traffic. There are also grade crossings in cities and villages on these trunk-line highways which should be eliminated by grade separations, but the cities and villages are unable to finance them.

"Therefore, I recommend to the General Assembly that appropriate legislation be enacted which will enable the Department of Public Works and Buildings to perform the necessary operations of maintenance, reconstruction or new construction of the streets occupied by our State highways through all the cities and villages of the State in so far as the needs of State trunk-line traffic require. Of course, such legislation should carry with it such safeguards as will insure that such maintenance or improvements do



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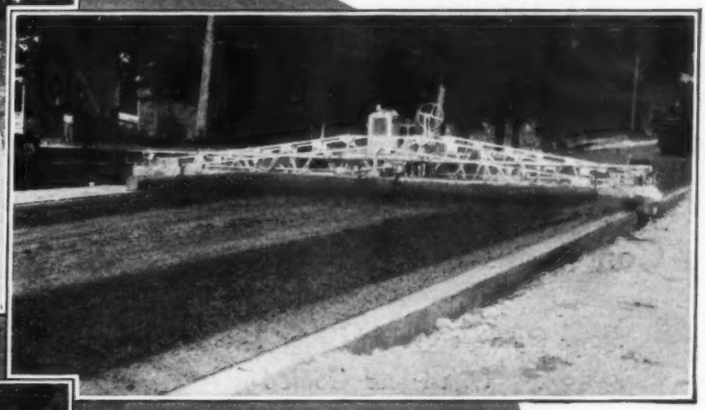

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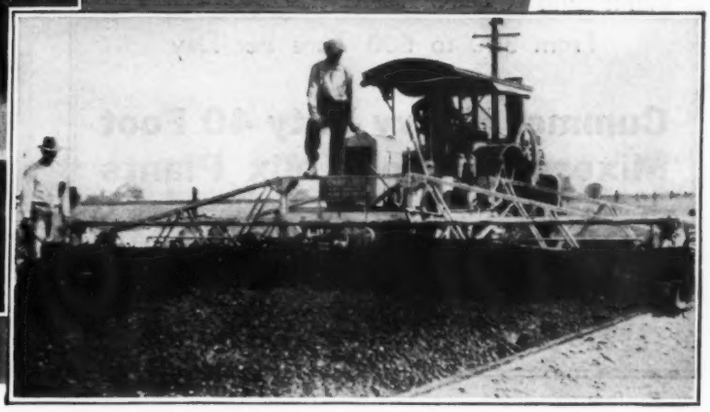

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not exceed the needs of State trunk-line traffic. The construction of belt lines around cities may frequently be advisable and legislation should be enacted authorizing such work when it becomes necessary."

Michigan.—"During the past year or two it has been possible for the State to participate with the cities in constructing streets over which the State routes trunk-line traffic. This policy should be continued, but no part of the State highway revenue should be devoted to other than highway uses or be spent without the supervision of the State Highway Department and the administrative board."

"It is recognized that certain streets in cities are a part of the great arterial system of highways comprising the State system, and should be given consideration as such. I would recommend that a definite plan of State participation in the cost of constructing, widening and maintaining trunk line streets through cities should be written into the laws. The municipalities should share in this cost, on a plan graduated according to their ability to pay, in recognition of the fact that a portion of the benefit of street improvement is strictly local."

New Hampshire—"House Bill No. 310 carried a bond issue of $750,000 for a loan to cities and towns by the State to permit the completion of the previously laid out trunk line highways."

Finances

Alabama.—"I believe that another road bond amendment should be submitted to the people and that it should be ratified for enough to finish paving our through roads.

"Complete paving of the State's through roads would bring through it much travel from without, and with the added revenue that would come from the resulting increased sale of gasoline, I believe that we would pay off the whole amount needed for their completion more easily and quickly than we by ourselves will be able to pay the $50,000,000 that have been issued heretofore. Besides, we would have the completed roads and a great stimulus would be given employment and business.

"I suggest for your consideration the submission of an amendment authorizing issuance of road bonds to an amount within two limits; the first limit being that the total face value of all bonds issued shall not exceed eight times the amount of net annual revenue available for its amortization, provided that when all of any series issued has been retired that series shall be eliminated from this first limit; the second limit being that the total amount outstanding at any one time shall not exceed a fixed sum, say $100,000,000.

"The reasons for the first limit—that the amount of all issues, any part of which is outstanding, should not exceed eight times the annual revenue, are—that to amortize a bond in 30 years requires about 6 per cent per annum of its face value; further—that to maintain average State roads requires about 4 per cent per annum of their cost, thus to pay for and to keep up the State roads required 10 per cent per annum of their cost. There should be added one-fourth of this amount to take care of emergencies, such as floods and economic depressions that reduce income after issuance. This means that 12½ per cent of the total cost of the roads are necessary each year for amortization, maintenance and marginal safety."

Delaware.—"The foremost achievement of the Highway Department within the last two years has been

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its ability to finance its 1930 construction work from current income alone. The real import of this is more apparent when it is understood to mean that the construction program can be continued at the present rate without issuing more bonds. In brief, the Highway Department is permanently on a 'pay as you go' basis, or at least is so long as it continues to be managed and operated in a strictly business manner."

Contract Work

Ohio.—"It is a matter of economic interest to know that there has been a reduced average cost of hard-surfaced construction from $2.54 per square yard during the year 1928 to $2.21 in 1929 and 1930, resulting in an increased mileage of 10 per cent without additional total cost. This was made possible through the expansion of contract work and competitive bidding in highway maintenance, the total saving, on the basis of former mileage costs, amounting to $2,000,000."

Washington.—"As a result of open competition in the purchase of materials by contractors, a substantial saving has been made."

Unemployment

California.—"The present period of unemployment may be a propitious time for the construction of needed improvements, having due regard to the already heavily burdened and distressed taxpayer, but it is not proper at this or any other time to expend public money for constructions that are not absolutely needed."

Illinois.—"Owing to the condition of unemployment and also to the desire to hasten road construction as much as possible, all available funds have been used in highway construction during the past year. Although all of the highway contracts contemplated for 1930 and obligating 1930 funds had been let, appropriation acts permitted the anticipation of assured revenues of 1931. This enabled the Department of Public Works and Buildings to place under contract several million dollars' worth of work for emergency highway and bridge construction to be started at once."

Missouri.—"One factor accelerating the progress of road building in Missouri was the advancing of the date of the release of Federal aid appropriations. The speeding up of the road program has been conducted during the Summer and Fall in such manner as to give relief to farming communities suffering from severe drought conditions. Local laborers were given preference in employment. During this period the Highway Department has had in its employ, on construction and maintenance, more than 10,000 men. This, together with the number employed in producing and furnishing the materials and supplies needed for road construction on such a vast scale, undoubtedly has helped greatly toward relieving the unemployment situation. It is fortunate that Missouri could engage in this great road building program at this particular time."

La Carretera Central de Cuba

(Continued from page 39)

Two major factors in the Central Highway cost were the grading and filling, and the construction of 2,392 bridges and culverts. Excavation in one 45-kilometer section in mountainous Oriente province cost almost $7,000,000 by the time the road was finished. In addition to the hundreds of grades, fills

and structures required by the uneven terrain, an overpass or underpass was built at every grade intersection. The Central Highway will never have a "grade crossing problem" such as is found in the United States.

There are no grades exceeding 5 percent. Curves were super-elevated and reduced in radius below the point of traffic hazard. Signs using international symbols have been installed at curves, elevations and other danger points. The entrances to all cities are marked with steel name-plates. Guard rail consisting of heavy steel cable with concrete posts has been installed across fills, around curves and in other danger zones. A five strand barbed-wire fence guards both sides of the highway throughout its entire length.

Previous to the construction of the Carretera Central, Cuba had built 2,667 kilometers, most of it well constructed of hard surface type 5 meters wide, but none even approximating the high standard of perfection of this highway. About 20 percent of the new highway followed the old right-of-way of the Colonial and other government roads, with the old width of 20 meters changed to 30 meters, and utilized the old macadam as a base. On the new right-of-way was placed a subbase of stone varying from 8 inches to 3 feet deep, according to the composition of the underlying soil. On this was poured a concrete base 6 inches deep in the center of the roadway and 9 inches at the sides. The final surfacing was asphalt, applied hot and raked and rolled to an even depth of 2 inches.

Ten-ton motor rollers were used on the sub-grade, and road finishing machines on the concrete base. When finished, the concrete was covered with sacking and kept damp for 24 hours, the usual curing period being shortened by the urgent need of the road for traffic.

To obtain stone for the subbase, quarries had to be opened in many places, as there were but two in operation in Cuba prior to the present road work. The cement used was of domestic manufacture.

Asphaltic materials were imported from the United States, as was all the mechanical equipment for the job. Excavating machinery, tractors and trucks, road finishers, cement mixers and machinery for asphalt manufacture purchased by the contractors totalled more than $3,000,000. The number of Cuban laborers employed amounted at the peak of activity to more than 10,000, which helped to minimize for the time at least Cuba's unemployment problem.

An unusual item of major importance was the importation from Georgia quarries of granite blocks for paving the cross-overs for sugar cane roads. Oxen drawn carts loaded with sugar cane had to cross the highway at hundreds of places on their way from the canefields to the sugar refineries. As these loads, weighing as much as seven tons, are supported on two high wheels with steel tires, the traffic would have been very damaging to the asphalt pavement, and all the crossings were paved with granite blocks.

The removal of huge ceiba trees, said to be a century old, constituted an unusual cost. These trees had been planted along both sides of the old narrow roadway, and they had to be excavated, pulled out by tractors, and the excavations filled with stone. Contractors were paid $15 each for their removal. Where it was possible, however, the trees were left. Rows of giant palms add a "local" touch in many places, enhancing the grandeur of the scenery.

Effect of Drought and Hard Times on Sewage Treatment at Worcester, Mass.

(*Continued from page 38*)

age of less organic content than would be expected. While the quality of the final effluent was as good as that of 1929, except for a slightly greater content of suspended organic matter which did not affect the average stability result, the percentage removal of organic matter was less in 1930 than in 1929."

The secondary tank treatment of the trickling filter effluent was more efficient than in 1929, yet the continuous heavy unloading of the filter resulted in the final effluent carrying a slightly greater quantity of suspended organic matter during 1930.

The cost of operation of the plant, based only on pay roll charges at the plant, was $6.24 per million gallons treated; but including all materials and supplies (including $4,800 for the two new bar screens), teaming and department transfers of labor the cost was $8.93 per million gallons—a total of $56,916.

Jacking a Storm Sewer Under a Busy Street in Nashville

(*Continued from page 56*)

E. J. Cullen, division engineer, Lehigh Valley, Auburn, N. Y.: "The 105 feet of pipe to be jacked from the opposite side of the embankment made the outcome of the project of considerable technical interest. The pipe was jacked to within 8 inches of the first section installed and found to be true to alignment and grade."

H. C. Archibald, supervisor of bridges and buildings B. & M. R. R.: "No difficulty was met in keeping the pipe on line and grade, and but little friction was encountered."

A. W. Paine, division maintenance engineer, State Road Commission, Parkersburg, West Virginia: "One of the 24-inch lines started to dip after it had been jacked about 30 feet, and to correct this tendency a wedge-shaped board was placed under the front end of the pipe while jacking. This board was removed without difficulty and moved forward at each resetting of the jack and answered its purpose satisfactorily."

A. J. Mowry, county engineer, Hoxie, Kansas: "Lining timbers consisting of 4 by 4's were set in the shallow trench leading to the backstop, to support and guide the pipe as it was jacked. These were supported by 3 by 8 cross timbers or sills centered about two feet apart. A plank was laid between the liners to give further support to the pipe and jacking equipment. Extreme care was taken to set the lining timbers to the exact line and grade, making it possible, as the final check-up showed, to come within 0.1 feet of the 0.8 feet of fall desired in the culvert."

C. H. Wood, district engineer, Kentucky State Highway Department: "The first operation was to construct a runway or track 80 feet long out from the outlet end of the culvert exactly on the line of the proposed flow line of the pipe and an amount lower equal to the thickness of the pipe plus the corrugations, and exactly centered on the center line of the culvert. These tracks were well greased. The sections of pipe were laid lengthwise on this track and placed tightly end to end. The collars were put around the adjoining sections, drawn tight and riveted into place. The result was a pipe seventy-six feet long and seven feet inside diameter, lying perfectly straight, true to line and grade of the proposed culvert."

It would appear from the above quotations that Armco corrugated pipe can be jacked from 50 to 100 feet within approximately 2 inches of pre-determined line and grade. We learn that adherence to alignment is governed somewhat by the type of soil encountered (it is sometimes hard at the top and soft at the bottom, or vice versa, which may cause it to dip or rise as the case may be), the amount of pressure exerted by the jacks, the point of pressure, and the methods of excavating. If instructions for jacking could be followed exactly, the pipe would come out exactly true to line and grade, but the human element and widely differing soils encountered cause the pipe to vary slightly in many installations.

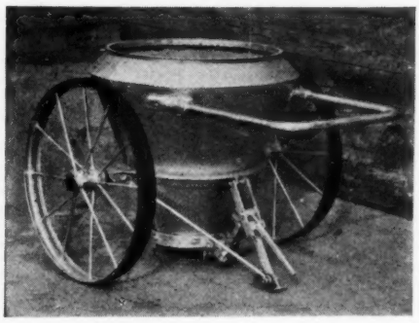
Pipe as small as 24-inch has been jacked, but the minimum recommended diameter is 42-inch; for the efficiency of men working in 42-inch pipe is so much greater that it makes up for extra cost of pipe and additional earth handled.

Saving by Using Bulk Cement in Road Work

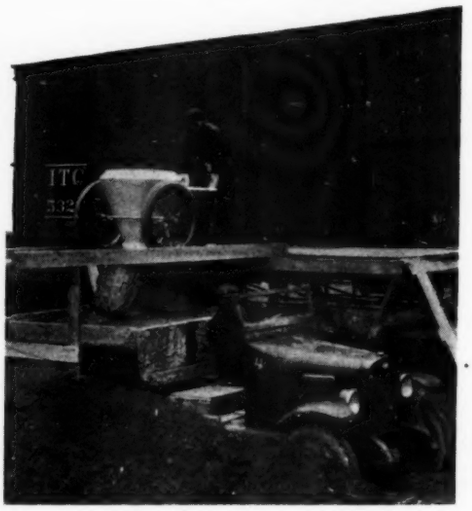
(Continued from page 56)

The labor required is generally equal to but need not exceed that required for sack cement.

Where the truck driveway is not low enough (and this is generally the case), it is necessary to excavate a depressed drive for the trucks, it being impractical to push the loaded carts up an incline to get over the top of the trucks.



Another disadvantage, where concrete carts or improvised carts have been used, has been the splashing of cement when dumping into trucks or industrial cars.



Above — A Johnson handcart.

At Left— Cart on branch platform dumping into a truck in a depressed driveway below.

The *bin and bucket elevator* system was described in PUBLIC WORKS, issue of January, 1929; and both bucket elevators and belt conveyors have formed features of several correcting plants which have been described from time to time in this publication.

The *bin and pneumatic pump system* is offered in two types, one where the pneumatic machine is pushed into the car to pick up the cement. The other type requires that the cement be dragged out of the car into a receiving hopper over the pneumatic pump. In either case the pneumatic pump discharges the cement through a pipe into a bin. The former type was described in the November 1930 issue of PUBLIC WORKS.

Tennessee Requires Orthotolidine Tests

Each public water supply in Tennessee using chlorine for sterilization is required to have an orthotolidine-testing set and to run tests daily to determine and report the amount of residual chlorine in the water after chlorination. An inexpensive testing set for this purpose is furnished free of charge by the Department of Health and during the past two years 36 test sets have been supplied to various public water supplies; also orthotolidine solution and permanent standards for refilling are furnished regularly to any supply upon request.

The Water Wheel

(Continued from page 69)

25. Proper Methods of Well Construction, A. G. Fiedler, pp. 1, 7, 9-10.

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26. Shall Illinois Have Sanitation and Conservation of Its Streams? Harry F. Ferguson, pp. 44-52.

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27. Some Problems of Railroad Water Supply, C. H. Koyl, pp. 1 and 5.

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*28. The Development of Railway Water Supply Practice, C. R. Knowles, pp. 481-494.

29. Private Cross-Connections and Similar Menaces to Public Water Supply Quality, Joel I. Connolly, pp. 495-508.

30. The Electric Pumping Station for New Brunswick, Asher Atkinson, pp. 509-513.

31. Legal Phases of Municipal Water Storage, Malcolm Lindsey, pp. 514-520.

32. Cement Lining of Used Cast Iron Pipe, J. R. Tanner, pp. 521-528.

33. Corrosion and Conservation of Underground Structures, P. J. Richards, pp. 529-533.

34. Some Unusual Corrosion Problems, F. B. Porter, pp. 534-537.

35. Mechanical Accounting for Water Utilities, P. H. Hutchinson, pp. 538-546.

36. Oiler Feed Water Treatment in Great Britain, A. W. Chapman, pp. 547-550.

37. Sand Spun Pipe, W. A. Brown, pp. 551-560.

38. The Old Mill Stream Project, Wilmington, Delaware, W. Compton Wells, pp. 561-564.

39. Gas Production and pH Determination of Coli-Aerogenes Cultures in Sugar Broths, C. C. Ruchhoft, J. G. Kallas and Ben Chinn, pp. 565-581.

40. An Attempt to Control Cyclops in a Water Plant, E. M. Johnson, pp. 582-585.

41. Water Witching, H. V. Pedersen, pp. 586-589.

42. Treating Highly Turbid Waters (discussion), George F. Gilkison, pp. 593-594.

43. The Modern Dowser (Editorial), Abel Wolman, pp. 595-596.

Journal of the New England Water Works Association, Vol. 45, No. 1, (March 1931.)

44. Disinfection of the Wanaque Aqueduct, Attmore E. Griffin, pp. 1-5.

45. Methods Attempted for the Prevention of Phenol and Other Tastes in the Water Supply of Rahway, New Jersey, pp. 6-14.

46. Pollution of Reservoirs by Gulls and Other Birds, G. C. Houser, pp. 15-20.

47. Water Waste Prevention, David A. Heffernan, pp. 21-22.

48. Breaks of Water Mains, Service Pipes and Hydrants (A Symposium), pp. 23-43.

49. Thawing Frozen Water Pipes, George H. Finneran, pp. 44-53.

50. Experiences with Water Mains and Cement-lined Pipe at Danvers, Mass., Roger W. Esty, pp. 54-65.

51. The Atlantic City Water Works, Lincoln Van Gilder, pp. 66-71.

*52. Water Hammer in Pipe Lines, Its Causes, Manner of Action and Effects, H. K. Barrows, pp. 72-85.

The Military Engineer, Vol. 23, No. 129, (May-June 1931.)

53. Comments on a Few Dams and Reservoirs (Conclusion), C. E. Grunsky, pp. 220-228.

54. Geological Survey Standard Current Meter, R. L. Atkinson, pp. 272-273.

Power, Vol. 73, No. 17, (April 28, 1931.)

55. Selecting the Motor to Suit the Pump, E. C. Dieffenbach, pp. 656-659.

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*56. Proper Well Construction, A. G. Fiedler, pp. 13-20.

57. Water Supply Service Offered by the Kansas Geological Survey, Kenneth K. Landes, pp. 21-23.

58. Methods for the Biological Examination of Water, W. C. Purdy, pp. 24-30.

59. Interpretation and Use of Biological Data in the Water Works Field, pp. 31-35.

60. Fire Stream Capacity of a Water Distribution System, J. O. Jones, pp. 36-39.

61. Designing Extensions to a Water Distribution System, R. O. Ruble, pp. 40-47.

62. Recent Developments in Odor and Taste Control, H. B. Crane, pp. 56-60.

63. The Advantages of Combined Mixing and Aeration, Herman Anderson, pp. 61-65.

64. Application of the Treasury Department Standards to Kansas Water Supplies, Cassandra Ritter, pp. 66-71.

65. The Business Affairs of a Public Utility, W. O. Meyers, pp. 72-77.

66. Operating Characteristics of Induction Motors, Dugald C. Jackson, pp. 85-91.

67. Water Ratings for 1930, Ernest Boyce, pp. 92-96.

68. A Review of Municipal Water Softening Practice in Kansas, R. E. Lawrence, pp. 97-101.

69. Some Filtration Kinks, L. B. Mangun, pp. 102-105.

70. Controlling Wash Water Rates by Sand Expansion, George F. Gilkison, pp. 106-108.

71. The Use of Ammonia in Water Treatment, Selma Gottlieb, pp. 109-112.

72. How Lincoln, Kansas, Secured a Water Softening Plant, M. J. Rees, pp. 113-115.

73. The History and Development of the Independence, Kansas, Water Supply, J. C. Gordon, pp. 116-120.

74. Mottled Enamel a Dental Defect and Its Occurrence in Kansas, R. W. Kehr, pp. 121-131.

75. Factors in Swimming Pool Design, M. P. Hatcher, pp. 132-135.

76. The Use of Admixtures in Concrete, W. C. McNown, pp. 136-139.

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77. The Determination of Moisture in Liquid Sulfur Dioxide, A. L. Flenner and W. R. Caverly, pp. 344-345, 360, 364.

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78. Modern Methods of Raising Water from Underground Sources, Rupert Allen, pp. 395-396.

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79. Rhosneigr, Anglesey, New Water Works, Anon., pp. 417-418.

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80. Diesel Engines as Applied to Water Works Service, R. D. Hall, page 440.

81. Automatic Water Pumping Stations, Leon Small, page 443.

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82. The Rainfall of 1930, J. Glasspoole, pp. 46.

83. Centrifugal Pumps—Curves and Their Interpretation, F. Johnstone Taylor, pp. 55-57.

84. Water Mains (Laying), Discussion of Paper by H. J. F. Gourley, page 57.

85. The Measurement of Water, H. B. Millard, pp. 62-66.

86. The Water Service of Singapore, pp. 66-68.

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87. Skipton Water Works, New 30,000 Gallon (per hour) Filtration Works, pp. 103.

88. The Metropolitan Water Board, New South Wales, p. 106.

89. Substances Producing Taste in Chlorinated Water—Part 1, B. A. Adams, pp. 109-113.

90. Rangoon Water Supply, pp. 115-117.

91. The Water Resources of America, (Work of the Geological Survey of the U. S. A.), N. C. Grover, pp. 118-119.

92. Scottish Rivers Pollution Prevention, 1st Report of the Scottish Advisory Committee on Rivers Pollution Prevention, page 119.

93. Treatment of Water and Its Effect on Ferruginous Encrustations, Arthur Goffey, page 121.

94. The Madden Dam Project, Alhajuela, Canal Zone, pp. 131-132.

Water Works Engineering, Vol. 84, No. 8, (April 22, 1931.)

95. Detroit Plant of Unique Design, John C. Thornton, pp. 496-497, and 535.

96. Effects of Recent Drought, E. S. Tisdale, 531-532 and 535.

97. New York Water Department Solves Many Operating Difficulties, W. W. Brush, pp. 499-500 and 528.

Water Works Engineering, Vol. 84, No. 9, (May 6, 1931.)

98. Antiquated Reservoir Rebuilt by Water Works Employees, W. G. Classen, pp. 561-562.

99. Sodium Aluminate Coagulation in Water Treatment, G. J. Fink, pp. 563-564, and 596.

100. The Law as to Taxation and Payments for Water Works Systems, Leo T. Parker, pp. 565-566 and 592.

101. Use of Indicating and Recording Instruments in Facilitating Water Works Operation, W. D. Rolfe, pp. 567-568, 588 and 591.

102. Accomplishments in Water Softening Practice in Kansas, R. E. Lawrence, pp. 584, 587.

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103. Rebuilding a Small Water Works Dam, W. G. Classen pp. 81-82.

104. Notes on the Painting of Standpipes, pp. 82.

105. Settling Basins for Coagulated Water, (Concluded.) John R. Baylis, pp. 85-90.

106. Fundamental Principles of Well Construction, A. G. Fiedler, pp. 94-96.

107. Operation of New York's Water Supply System, William W. Brush, pp. 97-99.

108. The Water Works Superintendent and His Job, W. Scott Johnson, pp. 100-102.

109. Problems of Water Works Operation, George H. Fenkell, pp. 103-104.

Emergency Chlorinators

The Tennessee Department of Health has two emergency chlorinators which are loaned by the department for service to public water supplies. One of the two solution feed type machines formerly owned was exchanged for a direct feed machine, making it easier to meet any condition which might arise. As formerly, the period of use of a lent emergency machine has been limited to 60 days. One of these machines was loaned and installed twice during the last six months of 1927, five times during 1928 and four times during the first six months of 1929. The department also has three 20-pound cylinders of chlorine for emergency use and on several occasions these have been lent to water supplies where the chlorine supply was exhausted before a new shipment was received.

For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 93

PUBLICATIONS OF VALUE

A New Hydrant.—One of the most beautiful circulars—and educational and valuable as well—that has come to our office describes the new Ludlow Dimond fire hydrant. You can get your copy from Ludlow Valve Mfg. Co., Troy, N. Y.

Pipe Line Equipment.—Litteford Bros., Cincinnati, O., have published a new bulletin on pipe line equipment and "hot dope" kettles. Ask for bulletin G-7.

Road Maintenance Unit.—The Austin Western Road Machinery Co., Chicago, Ill., has published Bulletin W-31-G describing their new one-man maintenance unit for tractor operation. This has 46 feet of cutting blades, and cuts 12 feet wide.

What Is The Difference?—This is a non-technical treatise on gasoline engine design and construction that tells the differences between various types of engines. What goes into an engine that makes for reliability, long life and good performance is explained and illustrated. Sterling Engine Co., Buffalo, N. Y.

Armco Perforated Pipe.—Dependable drainage, a dry surface at all times, and the absence of break-downs and repairs, are the main advantages of Armco perforated pipe given in a new well-ilustrated 24-page catalog, No. 4, just issued by the Armco Culvert Mfrs. Association, Middletown, Ohio.

Blueprints and photographs show how Armco perforated pipe has been successfully used to eliminate wet cuts, frost boils, soft spots, landslides, and for the drainage of large open areas. Its use in draining athletic fields, in reclaiming swamps, for airport drainage, mosquito elimination, and the draining of railway ballast pockets, is also thoroughly discussed as well as its application to other drainage problems.

A page is devoted to capacity and sizes. Helpful formulas are given, as are quotations from statements of actual users regarding results they have obtained with this product.

McCormick-Deering Industrial Tractors and Operating Equipment.—This book of more than 300 pages lists and describes not only McCormick-Deering Industrial Tractors, but the equipment manufactured for use with them. The text is divided into sections, and on the first right hand page of each section are listed the manufacturers whose equipment is described in that section. Cross references are given in most cases.

Among the equipment listed are the following: Air compressors, cabs, bumpers and trucks; cranes, shovels, loaders, backfillers and bulldozers; ditchers; drilling machines and pole setters, dump wagons and bodies; hoists, winches and side booms; locomotives and rail cars; lumber equipment; mowers; road machinery; scrapers and draglines; snow removal equipment; sprayers and dusters; stone crushers; trailers and hitches; wheel and track equipment.

There are 112 firms listed. It seems that everyone ought to have a copy of this valuable book which illustrates and describes such a large assortment of valuable machinery.

General Excavators.—A new bulletin, No. 3105, has just been published by The General Excavator Co., Marion, O. It describes the complete "General's Staff" including shovels, backhoes, clamshells, draglines, backfillers, skimmers, and cranes.

Air Made Wells. Bulletin 71-J has just been issued by the Sullivan Machinery Co., Chicago, Ill., as a temporary edition describing the Air Made Well for pneumatic pumping of sand and silt strata. This method, which combines the special well construction engineering of the Air Made Well Company of Kansas City and Sullivan Air Lift equipment and methods, has proven effective and successful when it is desired to develop water supply from shallow sand and gravel strata.

Gas + Air Shovel.—A bulletin on their recently announced GA-3 1¼-yard shovel-dragline-clamshell-lifting crane, has just been issued by Bucyrus-Erie Company of South Milwaukee, Wis. Excellently illustrated, this attractive book explains the principle of the Gas + Air and describes the many improvements made by the manufacturers in bringing out the new model. Basic patents protect Bucyrus-Erie's exclusive right to build this machine.

Specifications for Cement Lined Pipe.—A small booklet entitled "Tentative Specifications for Cement—Mortar Lined Cast Iron Pipe and Fittings," has just been published by The Cast Iron Pipe Research Association of Chicago. These specifications are tentative, and are subject to revision as additional information is obtained. The new specifications provide for thicker cement linings than have generally been used in American practice. Thicker linings are recommended by the committee on specifications as a matter of insurance.

Large Diameter Pipe.—Detailed information concerning large diameter Mono-Cast centrifugal pipe has been printed in booklet form and is now ready for distribution to all users, or prospective users of cast iron pipe. The booklet describes Mono-Cast pipe in diameter 14-inch to 24-inch inclusive, and is profusely illustrated.

The new booklet is to be used as a supplement to the American Cast Iron Pipe Co.'s Mono-Cast pipe booklet on the smaller sizes which has been in circulation for a number of years. Both booklets are the same size and can be carried in the pocket readily.

The specifications under which Mono-Cast pipe in sizes larger than twelve inches are being produced are practically the same as for the smaller sizes. In all essential points the specifications are in complete conformity with the specifications of the American Water Works Association, the American Society for Testing Materials, New England Water Works Association, the American Gas Association and the United States Government Master Specification for Centrifugal Pipe.

New Equipment

The 8-Yard Euclid Rear End Dump Wagon

This new Euclid wagon is particularly constructed for working under a shovel and for hauling rock, dirt, clay, sand or shale.

It features a rear gate allowing full 8-yard capacity loads and is so arranged to raise upward at a steep angle freeing the material at the start of the dumping and permitting ample space for discharging all loads. When hauling extremely large rocks this gate can easily be removed leaving the rear end open for easy discharge. In cases where driver does not get close enough to

Loadmaster Crane mounted on heavy duty Trackson-McCormick Deering tractor.

fill he can use the wagon as a Bulldozer to push the material over the fill.

This new gravity rear-end dump is mounted on the improved Euclid 15-ton track wheel assembly, which is exceptionally sturdy in construction and insures particularly low haulage costs.

Something New in Motor Trucks

The Sterling Motor Truck Company, Milwaukee, announce an entirely new and most complete line of motor trucks. The line includes 29 distinct models of various capacities from ¾ to 12 tons, in a broad array of wheelbase lengths in bevel, worm, double reduction, chain and dual drives for commercial and dump hauling. In addition to embodying many new mechanical developments, the appearance of the trucks has been greatly enhanced, adding beauty and symmetry of lines even in the heaviest capacity models. Such refinements as V-type radiators with wind deflectors, long sweeping crown fenders, hinged hood louvres, elaborately finished instrument panels, and De-Luxe cabs with adjustable seats and backs are apparent in the various models, taking them out of the category of conventional types.

Another interesting factor in connection with the announcement is new lower prices which include full chassis equipment and range from $795 for the 1-ton six to $12,000 for the largest model.

Euclid Tamping Rollers

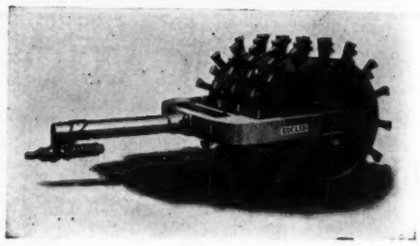
The latest Euclid Crane & Hoist development is the Euclid Single and Twin Tamping Roller. This is an improved design of the commonly known sheep's foot type of roller and features an oscillating action which permits the roller to conform to the contour of the ground.

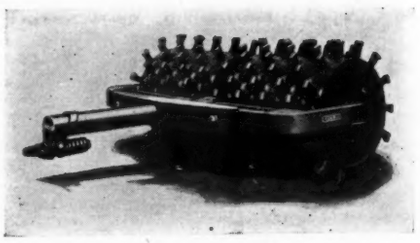
Both the single and twin tamping rollers are attached to the tractor by the Euclid drawbar spring-mounted clevis thus eliminating a rigid direct jerk when starting and relieving both tractor and equipment of excessive strain. The rolls are built of high grade steel with cast steel teeth welded to the roll. These teeth are designed to be as nearly self cleaning as possible.

A great many state departments require the use of this type of equipment in all fills. It is the quickest, easiest and most economical method for settling or compacting fills on highways, railroads, dams and similar work.

New Insley Shoulder Finishing Device

The National Equipment Corporation, Milwaukee, announces a new shoulder finisher designed and built by the Insley Division, the purpose of which is to shape a road shoulder and berm





Euclid Single and Double Tamping Rollers.

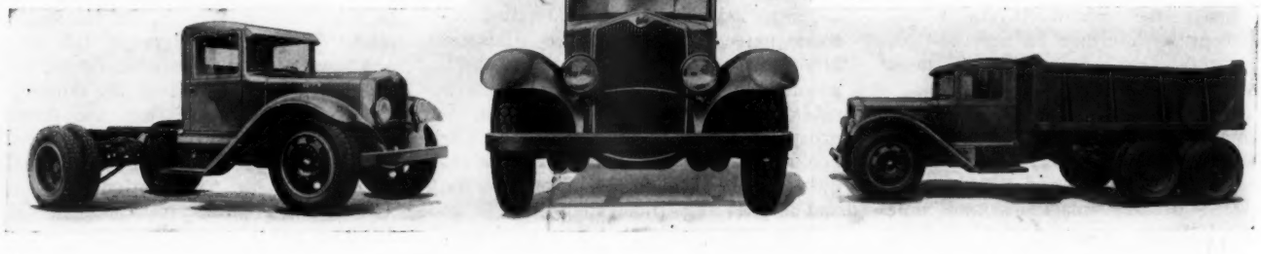
accurately once the proper amount of dirt has been put on the shoulder. It consists of a platform mounted on pneumatic tires, this platform carrying an A-frame and column supporting a set of blades which conform to the required specifications. It is made with three sizes of blades, 8 ft., 10 ft. and 12 ft. 6 in. and can finish any shoulder from 5 ft. to 11 ft.

The unique feature of the Insley Shoulder Finisher is the use of a guide bar near the rear of the machine, which bar runs along the edge of the finished slab and holds the entire machine in exact line so that the relation of the edge of the slab to the edge of the berm is automatically fixed. When the machine is used on a job other than concrete slab this guide bar is not used and the machine has enough weight and stability to enable it to carry a full blade without shifting the rear end sidewise. Owing to the distribution of the weight the Insley Shoulder Finisher can carry a full blade either with or without the guide bar.

The usual procedure in building shoulders with this machine is to put more than sufficient dirt on the shoulder and run over the shoulder to make a rough cut. This operation is then repeated, bringing the shoulder down to the finished grade and turning the angle of the berm. The machine is pulled by a tractor running on the shoulder rather than on the slab making it possible to finish shoulders closely behind the paver.

The new Sterling heavy duty motor trucks show many new features.

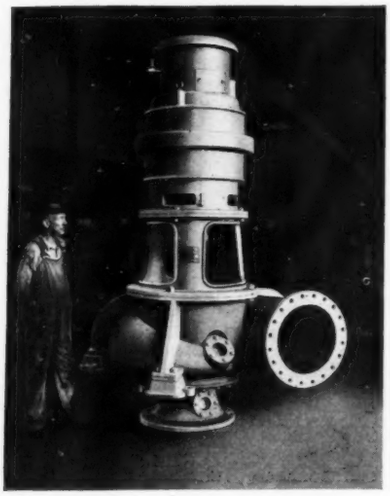
The complete line includes 29 models, from ¾ to 12 tons.



FOR THE WATER WORKS MAN

High Speed Pumps for Low and Medium Heads

The Moody High Speed Pump, manufactured by I. P. Morris & De La Vergne, Inc., Philadelphia, is a distinct departure from the conventional centrifugal type and has been developed to meet economically the demands of modern large capacity low head service. The Moody High Speed Pump operates at more than double the speed of a centrifugal pump, designed for the same conditions. This



The Moody High-Speed Pump

makes it possible to take advantage of the much reduced size and cost of the modern high speed motor. In addition to this, the higher speed results in decided reduction in the size, weight and cost of the pump itself and of the entire pump-house and substructure. These advantages combined with high efficiency operation and the ultimate in reliability, due to correct hydraulic and mechanical design, have extended considerably the economic possibilities of low head pumping.

The field of application of the Moody High Speed Pump is, for the most part, limited to heads under about forty feet with unit capacities ranging from 300 G.P.M. up to the largest capacities which may be demanded. It is not, as a rule, required to take the place of multi-stage centrifugal pumps, as in such cases its speed would be usually too high, but in the low head field, to which it properly belongs, it has many applications.

The Moody High Speed Pump maintains high efficiency over a considerable range in head as shown by the flat efficiency curve. The curves and efficiencies obtainable in larger pumps reach for example, about 83 per cent for a 40-inch impeller.

With variation in head, over a normal operating range, there is comparatively little variation in discharge, the power required decreases as the head is decreased and under low head conditions there is no overloading of the motor. With any tendency of semi-liquids to clog the line, reduced discharge increases the head and consequently tends to maintain the flow and to clear the line.

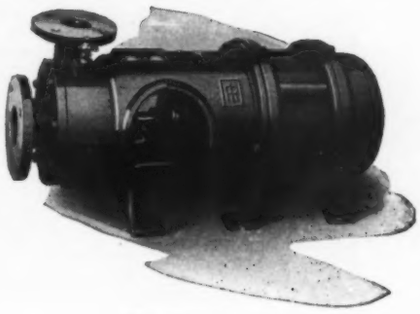
New Cameron Centrifugal Pump

A new Cameron general service centrifugal pump, designated as the Class "RV," is announced by Ingersoll-Rand Co., 11 Broadway, New York City. Both the pump and the electric motor that drives it are assembled together, producing a compact, lightweight, easily handled unit. The Class "RV" is suitable for such applications as circulating and cooling systems, standpipe and water supply systems in factories, warehouses and apartment buildings; and general transfer and handling service of any reasonably clear liquid.

This pump is made in six sizes and can be furnished mounted on a structural steel bedplate to facilitate installation, if so desired. Detailed information regarding this pump can be obtained from PUBLIC WORKS or from the manufacturer.

A Handy Tool for Handling Pipe

The Allsteel Products Mfg. Co., Wichita, Kans., manufacture the Cardwell Allsteel Winch. This equipment



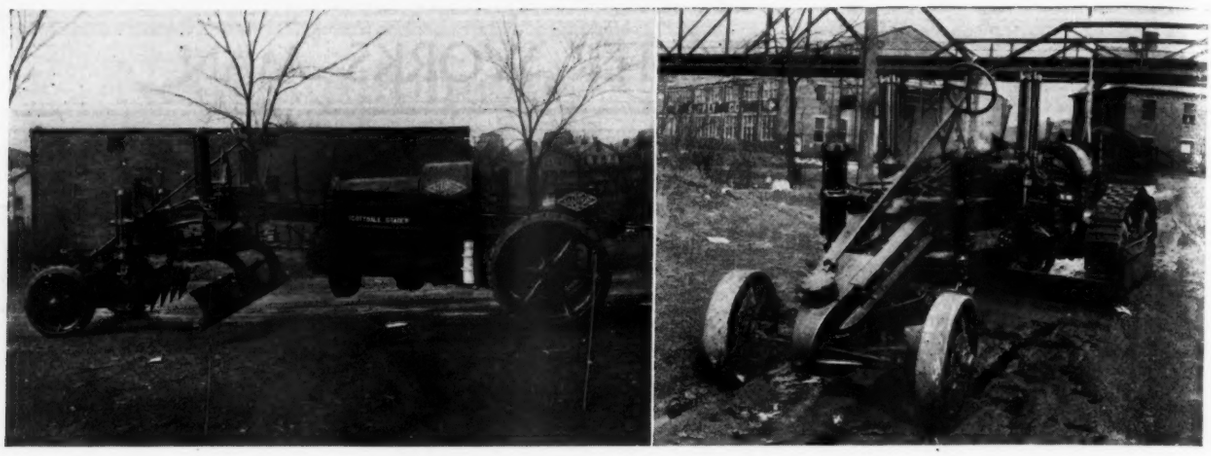
The Cameron Pump

was primarily designed for the handling of all sizes of pipe by sewer and water pipeline contractors, but it also has a wide field of usefulness in the handling of other heavy and bulky materials. It provides the combined utility of traveling crane, revolving crane and portable power hoist. It is made in a variety of sizes. The accompanying illustration shows a PA-20 double drum, liveboom sidewinch employed in handling, lowering and backstabbing cast iron water main for the Wichita Water Co. According to John J. Farmer, construction superintendent, this unit handled and laid the pipe in less time than it formerly required to set up the hand equipment previously used in laying mains of this size. This winch is made in three sizes.

Curtis Portable Air Compressor

Curtis Pneumatic Machinery Co., St. Louis, Mo., has introduced its new Curtis Model C high speed Timken rol-

The All Steel Sidewinch handles pipe easily.



The Scottdale hydraulic controlled road grader.

ler bearing portable air compressor. This is made in four sizes and two styles. The 40 and 60-cu. ft. machines are 2-wheel trailer type portables, while the 80-ft. and 120-ft. capacities are mounted on 4-wheel truck trailers.

An important feature of these compressors are the carbon-free valves and head, which have been developed through much research.

Hydraulic Controlled Road Grader

The Marion Scottdale Grader, manufactured by the Marion Machine, Foundry & Supply Co., Marion, O., and Scottdale, Pa., is power driven, and utilizes hydraulic power to operate the blade and scarifier, thus eliminating all worm gears, pinions, screws, hand wheels, etc. When hydraulic power is applied, the action is positive. A slight forward thrust of the operating levers starts immediate action of either blade or scarifier or both as the operator desires. Practically no physical effort is required.

The power plant is the McCormick-Deering 10-20 Industrial Tractor with agricultural tractor high speed gears. The track which permits the operation of the grader in soft ground and also gives it tremendous tractive power is different from any track now on the market. This grader has been under the most gruelling trials but has experienced no difficulty in moving unusually heavy loads.

The crawler drive and grader are provided with Alemite oiling system throughout with exception of steering gear which is lubricated with cup grease.

An Aluminum Straight Edge for Better Work

A new Aluminum Straight Edge has been put on the market by The Cleveland Formgrader Company, Cleveland, O. The particular features of this improved straight edge are that it comprises a box section with flat bottom for checking the pavement surface together with a double thick web and hemmed top for strength and stiffness.

Because of its ingenious design, it is possible to obtain greater strength in this straight edge blade with a weight of only four pounds.

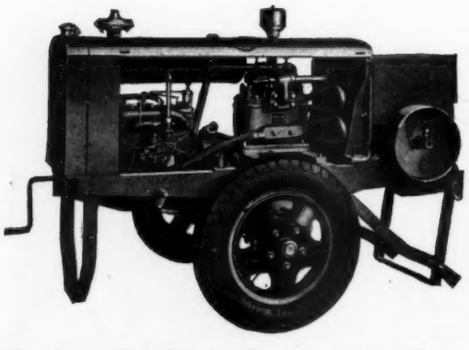
Other advantages of this new straight edge are that it employs an aluminum handle which is lighter but at the same time stiffer than wood and, also, the braces which assist in holding the straight edge blade to the handle are of aluminum for further lightness.

The straight edge blade is ten feet in length which complies with the majority of specifications of the different Highway Departments.

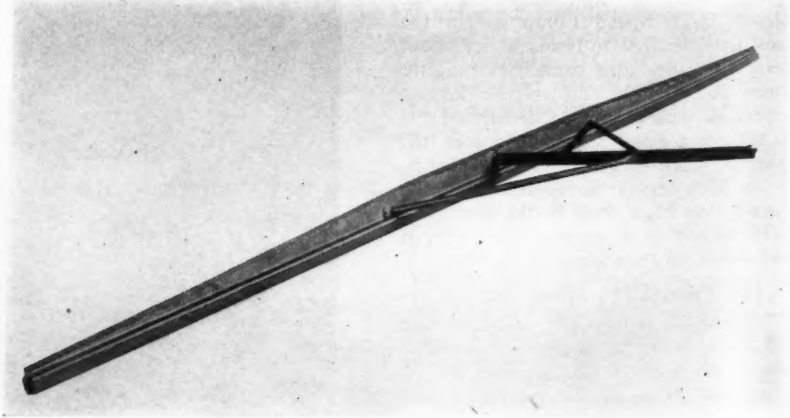
Armco Boring Machine for Installing Small Pipe

Increasingly heavier rolling equipment and high speeds have emphasized the need for a quick, economical method of installing highway drainage which would not interfere with the use of the traveled surface. This need has been met by the development by the Armco Culvert Mfrs. Association, during the past four years, of a boring machine, designed for the express purpose of installing corrugated iron drain pipe in 8, 12, and 18-inch diameters.

The Armco boring machine serves the double function of excavating and removing the material replaced by the pipe. The entire machine is mounted on a track upon which it is moved forward as jacking progresses. The jacking itself is done by hand at the rear of the machine by means of an especially designed jack operating on a rack between the rails of the track on which the machine moves. Power for excavating is provided by a gasoline motor and is transmitted to the "borer" by a shaft extending through the pipe.



The Curtis Portable Air Compressor is made in a variety of sizes.



The new type aluminum straight edge.

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Construction Methods and Equipment

Accessories, Motor Truck

1. Truck accessories—winches, power take-offs, derricks, special bodies, earth boring machines, and trailers of all capacities are described in a series of folders issued by the Four Wheel Drive Auto Company, Clintonville, Wisconsin.

Asphalt Heaters

8. A 54-page booklet issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illutsrates oil, wood and coal burning asphalt and tar kettles, tool heaters, sand dryers, tool boxes, traffic line markers, grout mixers, asphalt tools and their use in road construction.

9. "Hotstuf," the master oil burning heater, is the only heater with patented elevated melting chamber for Asphalt, Tar and all bitumens used in road and street construction and maintenance, roofing, water proofing, pipe coating, etc. Described in illustrated manual No. 11—Mohawk Asphalt Heater Co., 94 Weaver St., Schnectady, N. Y.

Asphalt Plants

10. J. D. Farasey Mfg. Company, Cleveland, Ohio, issue a booklet for use and specifications for Farasey Portable Asphalt Paving Plants. These R. R. 1-car plants have easy capacity of 2,250 yards, 2" surface per 8 hours. Cheap to operate.

Asphalt Rollers

12. A 16-page booklet printed in two colors gives full details and specifications of the Erie Roller. Also explains how to use it to save tamping costs. Numerous action pictures. Issued by the Erie Machine Shops, Erie, Pa.

Chip Spreaders

25. The Universal Road Machinery, Company of Kingston, N. Y., have issued a booklet describing their Reliance Chip Spreader, a special trailer, operating in the reverse direction, designed for resurfacing bituminous highways. Spreads to a width of 8' to any desired thickness.

Clamshell Buckets

27. The Owen Bucket Company, Cleveland, Ohio, have available illustrated folders on Clamshell Buckets showing the various types, sizes and uses for which they are intended and construction features and other valuable bucket information. A complete catalog on all types of Clamshell Buckets will also be furnished on request.

Concrete Accelerators

30. "How to Cure Concrete," a forty-seven page manual published by the Dow Chemical Company, Midland, Michigan, treats fully the subjects suggested by its title. A well-illustrated and instructive volume.

31. "Curing Concrete Roads with Solvay Calcium Chloride," 30 page booklet. Comprehensive. Contains tables, illustrations, suggestions for testing devices. Covers the subject in considerable detail. Published by the Solvay Sales Corp., 61 Broadway, New York, N. Y.

35. "A report on Current Practice of using Calcium Chloride for curing Concrete Pavements, Building Construction, Bridges, Culverts and Concrete Products." Concise practical data, embodies latest information on subject. Issued by Columbia Products Co., Barberton, Ohio.

Concrete Mixer

44. Jaeger Concrete Mixers, both Tilting and Non-Tilting types, from 3½s to 84s size, with illustrated descriptions of all types mounting, power and loading equipment—64 pages published by The Jaeger Machine Company, Columbus, Ohio.

Crushers

56. Pioneer Gravel Equipment Manufacturing Company, Minneapolis, Minnesota, publishes complete 80-page manual, showing blue print sketches of set-ups in pit or quarry of the eleven different sizes of Pioneer Crushing Plants.

57. Up-to-date information on Stone Crushers, Stone Spreaders, Unloaders, Drags and other contractors' equipment from the Galion Iron Works & Mfg Co., Galion, Ohio.

59. A new booklet has just been issued by the Universal Road Machinery Company of Kingston, N. Y., describing their full line of portable and stationary crushing, screening and washing units.

Culverts—Large Diameter

60. Ease and speed of installation, economy, a full-width roadway and durable, maintenance-free service, are listed in the new catalog, "Armco Large Diameter Corrugated Pipe," as the advantages following the use of larger diameter culverts in meeting small bridge requirements. Catalog No. 8 will be sent free on request. Address Armco Culvert Mfrs. Association, Middletown, Ohio.

Drag Lines

61. Write for complete catalog on Pioneer Drag Line. Catalog shows cross section of Drum Unit with full description of Frame, Sheaves, Motor and Bucket.—Pioneer Gravel Equipment Mfg. Co., Minneapolis, Minn.

Dump Wagons, Spring Wind-Up

68. Bulletin W-30-J, just issued by Western Wheeled Scraper Company, Aurora, Illinois, illustrates and explains the new Western Automatic Spring Wind-up with which all Western Crawler dump wagons, either new or in service, can be equipped without requiring any attachment on the tractor. This device makes the employment of a wagon man unnecessary.

Dump Wagons, Steel

70. Steel Dump Bodies and hydraulic hoists for Fords and other small trucks are described and fully illustrated in technical literature published by the Wood Hydraulic Hoist and Body Co., 7924-60 Riopelle St., Detroit, Mich.

71. "Steel Dump Bodies." Full data on steel dump bodies for every type of hauling proposition and description of special "Self-Dumper Bodies" for road Builders. Wood Hydraulic Hoist and Body Co., 7924-60 Riopelle St., Detroit, Mich.

Finishing Machine

75. Complete description of Lakewood Finishers, showing use of single and tandem screeds and tamper attachment for high speed production on concrete and bituminous pavements, city streets and highways—32 pages published by The Lakewood Engineering Company, Columbus, Ohio.

Graders

76. Elevating Graders. Two publications by the Caterpillar Tractor Co., Peoria, Ill., illustrate the Caterpillar Sixty Grader with and without engine.

Excavating Buckets

80. The Owen Bucket Company, Cleveland, Ohio, have available illustrated folders on Excavating Buckets showing the various types, sizes and uses for which they are intended and construction features and other valuable bucket information. A complete catalog on all types of Excavating Buckets will also be furnished on request.

Hoists, Truck

85. "Dump Truck Hoist." Double the Truck's value by using power operated Hydraulic Hoists. Catalog of WOOD Hydraulic Hoist and Body Company. Detroit, Michigan, describes Hydraulic Hoists for every make and model of Truck.

Hoppers, Measuring

86. The C. S. Johnson Co., Champaign, Ill., publish a booklet which describes the Johnson Demountable Bins and Measuring Hoppers. Data sent on request.

Hose and Belting

87. Complete information on rubber hose and belting for all types of contracting and road building service available from the Government Sales Department of the Goodyear Tire & Rubber Co., Inc., Akron, Ohio.

Lanterns and Torches

90. Send for interesting catalog in colors of Dietz Lanterns and Road Torches adapted for night traffic warn-

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ing on any construction work that obstructs the highways. R. E. Dietz Co., 60 Laight St., New York, N. Y.

91. An illustrated folder in two colors has just been printed describing the Toledo Torch for illuminating hazards on highway and other construction. Issued by the Toledo Pressed Steel Co., Toledo, Ohio.

Loaders and Unloaders

96. Portable car unloaders save money for the contractor on road and other construction projects. Full information on this and on the Reliance Chip and sand spreader on request. Universal Road Machinery Co., Kingston, N. Y.

97. Link-Belt Company, Philadelphia, describes a line of Portable Loaders and Unloaders in Folders: Nos. 1073 and 1074 cover Belt Conveyors with channel iron and truss types of framework; No. 1076, Portable Bucket Elevators for different classes of work; and No. 1149, the "Grizzly" Crawler Loader for heavy work and large capacities.

Motor Trucks

106. "Operating Trucks Profitably in Contracting"—A 24 page survey with practical data on efficient truck operation and what to consider in selecting new equipment just published by General Motors Truck Company—Pontiac, Mich.

107. "Trucks for Federal, State, County and City Governments," a booklet issued by Dodge Brothers, division of Chrysler Corporation, gives information about company's trucks in municipal, county, state and government activity.

108. Four-wheel-drive trucks to increase the range of truck operation and for economy of operation for use in road building and maintenance, described in a series of new folders just issued by the Four Wheel Drive Auto Company, Clintonville, Wisconsin.

Paving Materials

109. A 36 page booklet with 66 illustrations has just been issued by the Barrett Co. giving full information regarding the making, laying and maintaining of "Tarvia-lithic," the ready-to-lay pavement.

111. "Tarvia Double Seal Pavements." Shows, step by step, the construction of a Tarvia pavement. Profusely illustrated with photographs, 24 pages. The Barrett Company, 40 Rector Street, New York.

Plows

112. Plows, Grade Rippers (Scarifiers) and Scrapers are fully illustrated in a new catalogue which will be sent upon request by Wiard Plow Company, Batavia, N. Y. Oldest Plow manufacturers in America.

Power Graders

117. A large wall display piece, No. 3101, printed in three colors and containing a very large illustration of the WARCO Model "E" power grader as well as complete description and working views on center control graders will be sent by the W. A. Riddell Co., of Bucyrus, Ohio, to anyone interested.

Pumps, Contractors'

119. 'Domestic' Contractors' Pumps. Automatic Priming, Ball Bearing Centifugals 2½" to 6" sizes. 'Giant' Road Pumps, 80 and 100 gallons per minute. Dependable Diaphragm and Plunger Trench Pumps and Hoists. Special Bulletins. Domestic Engine & Pump Co., Shippensburg, Pa."

122. Humdinger contractors' pumps. Diaphragm pumps in both the open discharge and the diaphragm force pump types. Self-priming Centrifugal pump, for automatic continuous prime on suction lifts up to 28'. Are described fully and valuable practical information for contractors is given in special Bulletins #107-A and 1034. Ralph B. Carter Co., 53 Park Place, New York, N. Y.

Road Construction

123. "Road Construction and Maintenance" are covered in a new Cletrac Booklet, which takes up such subjects as modern methods of handling large capacity equipment, tandem equipment, etc. Cleveland Tractor Co., 1932 Euclid Ave., Cleveland, Ohio.

124. Building Roads Better, Cheaper and Quicker. A book by the Caterpillar Tractor Co., Peoria, Ill., telling how smooth, well-built roads can be built better, cheaper and quicker. It pictures the machines which do this work, and tells how the machine's economy, dependability and stamina are important.

Road Rollers, Scrapers, Graders, etc.

125. Plows, Grade Rippers (Scarifiers) and Scrapers are fully illustrated in a new catalogue which will be sent upon request by Wiard Plow Company, Batavia, N. Y. Oldest Plow manufacturers in America.

126. Illustrated catalogs and descriptive material HERCULES All-steel, 6-cylinder road roller. 60 H.P. Gasoline engine. Sizes 5, 7, 8, 10, 12, and 15 tons. Three speeds forward and backward. Cast Steel rollers. The Hercules Company, Marion, Ohio.

127. A 16-page booklet printed in two colors gives full details and specifications of the Erie Roller. Also explains how to use it to save tamping costs. Numerous action pictures. Issued by the Erie Machine Shops, Erie, Pa.

128. A beautiful 32 page book in four colors featuring their entire line of road rollers has been published by the Buffalo-Springfield Roller Co. of Springfield, Ohio. 8¾ x 11, leatherette cover, numerous action pictures.

129. Caterpillar publications as follows: Sixty Leaning Wheel Grader, the Super-Special Grader, the Motor Patrols, the Twenty Planer, the Hi-Way Patrol Grades No. 3, the Ten Motor Patrol, and the Auto Patrol. These cover a wide range of valuable and useful information on road-building machinery. Caterpillar Tractor Co., Peoria, Ill.

131. 20-page pocket size booklet showing all types of Buffalo-Springfield motor rollers and scarifiers. The Buffalo-Springfield Roller Company, Springfield, Ohio.

132. "Road Machinery." A sixty-four page data book has been issued by the Austin-Western Road Machinery Company, 400 No. Michigan Ave., Chicago, describing their full line of road building machinery. Included in it are illustrations and descriptions of road graders, 5-foot blade to 12-foot blade; road rollers, steam or gasoline powered, 3 to 15-tons single cylinder to four cylinder. Motor graders, three sizes. Scarifiers. Crushing plant equipment, small road tools. Special bulletins on each separate piece of machinery supplement the general catalog.

133. "Road Rollers." New illustrated booklets covering the entire line of Master 4-Cylinder motor roller, 4-cylinder tandem roller and International motor roller. Gallon Iron Works and Manufacturing Co., Gallon, O.

134. 36-page, illustrated book describing mechanical features of Huber 4-cylinder Motor Roller and its application to many types of road construction and maintenance. Huber Mfg. Company, Marion, Ohio.

135. Road Machinery Illustrated. New illustrated bulletins on the master Motor Roller, Three-Wheel and Tandem Rollers, Motor Graders powered by Caterpillar, Twin City, Cletrac, McCormick-Deering and Fordson tractors, and Straight and Leaning Wheel Graders. Galion Iron Works & Mfg. Co., Galion, O.

136. Full description of Huber Motor Rollers in sizes from 5 to 15 tons, included in durable 36-page book for use by road contractors and maintenance crews. Huber Mfg. Co., 345 E. Center St., Marion, Ohio.

137. Road Machinery. Comparative specifications of the various types of equipment manufactured by the Caterpillar Tractor Co., Peoria, Ill.

Sand and Gravel Washing Plants

138. The Dorrco Sand-Washer is inexpensive to install and operate, and produces a clean, drained sand with a minimum of waste. It will make separation at any point between 20 and 100 mesh. Ask for bulletin No. 4101. The Dorr Co., 247 Park Ave., N. Y.

139. Up to date information on Portable Sand and Gravel Washing Plants with concrete capacities, ranging from 30 to 100 yards per hour.—Pioneer Gravel Equipment Mfg. Co., Minneapolis, Minn.

Screens

140. Full information concerning Shaker and Revolving Screens, Conveyors, Elevators, Bins and Chutes is contained in catalog and special illustrated folders on Pioneer line. Write Pioneer Gravel Equipment Mfg. Co., Minneapolis, Minn.

Shovels, Cranes and Excavators

142. The Cranemobile, "successor to Trench Cranes," an adaptation of the crawler mounted Bay City Tractor Shovel is fully described and illustrated in Bulletin C2 just issued by Bay City Shovels, Inc., Bay City, Mich.

145. Catalog K3 just issued, completely describes the light half yard and the full half yard convertible shovel, crane, dragline, trench hoe and skimmer manufactured by Bay City Shovels, Inc., Bay City, Mich. 28 pages, over 50 illustrations, action pictures and charts.

151. The complete line of ½-yd. to 1½-yd. shovels, cranes, draglines, ditchers and skimmers manufactured by the Orton Crane & Shovel Co., 608 S. Dearborn St., Chicago, Ill., is described in Bulletin 60, which also gives lifting capacities and working ranges for the different sizes and types of these crawling tread machines.

Steel Forms

155. A well illustrated catalog of Steel Forms for concrete road, curb and sidewalk construction is available from The Heltzel Steel Form & Iron Company, Warren, O.

Steel Bins

159. Steel bins and measuring hoppers are included in a fully illustrated catalog of Contractors Equipment issued by The Heltzel Steel Form & Iron Company, Warren, Ohio. Write for your copy.

Steel Posts

160. Steel Posts for all purposes. Sweet's Herculean Steel Posts for highway guard rails, fences and other purposes. Catalog and data book. Sweet's Steel Company, Williamsport, Pa.

Tires, Truck and Car

165. Solid, cushion and pneumatic tires and tubes for trucks, cars, tractors, graders and other road machinery. Full information and data available from Government Sales Department of the Goodyear Tire & Rubber Company, Inc., Akron, Ohio.

Tractors, Crawler

168. "High Clearance," "Caterpillars in Mines, Quarries, Clay Plants and Pits," "The Caterpillar for Industry," "The Caterpillar for Railroads," "For the Earth Mover," are publications of the Caterpillar Tractor Co., Peoria, Ill.

169. Cletrac crawler tractors. Cleveland Tractor Co., 19322 Euclid Ave., Cleveland, O. Bulletin 562 describes their use in roadbuilding and maintenance, earth moving, excavating, grading, snow removal, oil field work and lumbering. Made in "20," "30," and "40" and "100" sizes.

170. "Roads," a series of five fully illustrated folders, prepared by the Caterpillar Tractor Co., of San Leandro, Calif., and Peoria, Ill., shows what Russell graders and "Caterpillar" tractors can do and are doing to build better roads quicker and cheaper.

New Ideas for the Engineer and Contractor

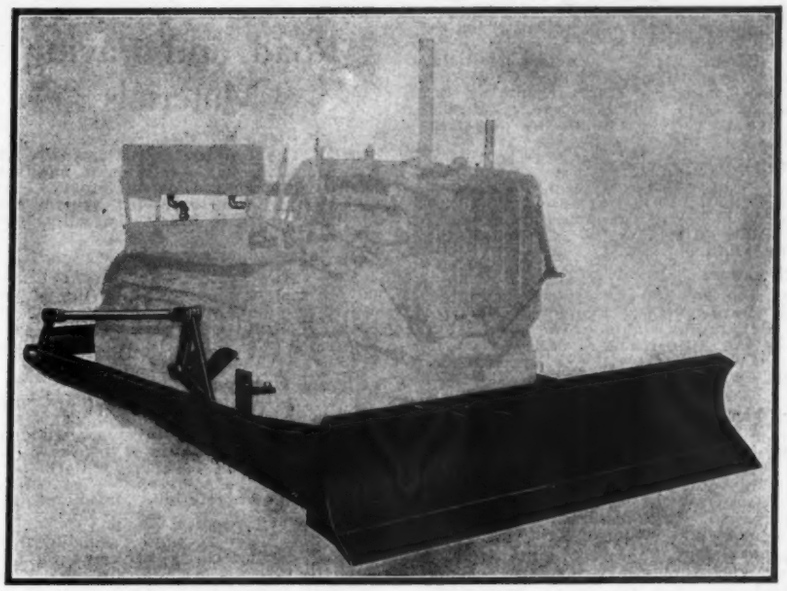
"BLJ" Road Oiler Introduces New Features

Containing many features, including an accurate volume gauge, operating levers in the driver's cab providing one-man control, a heating unit built into the tank and swivel manifold extensions which permit the shortening or lengthening of the spray bar at will, a new "BLJ" Unit was introduced a short time ago by the Sacramento Engineering and Machine Works, of Sacramento, California. The Edward R. Bacon Company is the distributor.

This machine eliminates any possibility of distributing the road oil at an improper temperature, and on simple jobs of fuel oil spraying, one man can do the entire job easily, controlling the spreader valves from the driver's seat. Also, the swivel joints near each end of the spraying manifold allow the extensions to be turned in so that the bar does not project beyond the side of the truck. This permits the unit to travel on open highways with perfect safety.

Exact temperature control of road oil is accomplished. The heating plant consists of two 6 in. flues located at the front (or firebox end) of the tank and extending into the tank up to, but not through the back end. Return bends are placed in these. Two large straight flame kerosene burners, operating under pressure, are used to heat the oil and are directed into the flues. Thus the heat passes the entire length of the tank three times. A supply tank of 25 gallon capacity for the kerosene is furnished which carries enough fuel for three hours operation with the burners wide open.

The temperature of the oil is raised from three to four degrees per minute, fast enough to provide ample time for heating the oil while the truck is traveling to the job.



A Backfiller-Bulldozer

Hydrig Backfiller-Bulldozer

The Hydrig Backfiller-Bulldozer is designed to incorporate in a single unit the strength of a bulldozer with the versatility of a reversible blade backfiller. It cuts costs and increases profits for the earthmover by backfilling, bulldozing, leveling, digging, smoothing, trail building, removing snow and handling other earth-moving tasks quickly, efficiently and economically.

It consists of a reversible blade pivoted on a frame yoke in front of the tractor. It is held in position by the pivot and by supporting struts connecting with side members which rest on the track frames of the tractor. An hydraulic jack, rigidly mounted to the drawbar frame, actuates the patented Hydrig lifting device, enabling the operator to control the cutting or spreading depth of the moldboard. The blade can be quickly changed from the usual bulldozer position to an angling one by removing two pins and swinging the moldboard. If desired, an easily-attached end point is provided for cutting into banks and for dislodging trees and boulders. Great capacity is obtained by perfect balance and a moldboard correctly curved to provide the most efficient cutting angle—it digs in and rolls the dirt ahead instead of merely shoving it —maximum yardage from minimum power.

The Hydrig, which is manufactured by the Davis Mfg. Co., Davis, Calif., is made in two sizes for "30" to "40" tractors; and for "50" and larger tractors.

Valuable new features are incorporated in this road oiler.

Tarvialithic.—An excellent booklet telling in detail about the properties of this pavement, how to lay, handle and store it, and its advantages. Considerable valuable information is included, and the construction of this type of pavement is illustrated step by step with many excellent illustrations. It is published by the Barrett Co., New York. A copy will be sent on request to them or to PUBLIC WORKS.

171. The design, construction, details and complete specifications of the new Ten and Fifteen models "Caterpillar" are given in a booklet recently published by the Caterpillar Tractor Co. of San Leandro, Calif., and Peoria, Ill

172. The Caterpillar Sixty Tractor. This beautifully illustrated booklet tells the story of the Caterpillar Sixty Tractor design and construction. Caterpillar Tractor Co., Peoria, Ill.

173. Cletrac Crawler Tractors are built in a complete line by The Cleveland Tractor Company, 19322 Euclid Ave., Cleveland, Ohio. Cletracs range in size from the 12 h. p. model to the powerful 100 h. p. tractor.

Tractors, Wheel

175. "Huber Tractors" and "The Huber Motor Rollers." Illustrations of machines in operation and testimonials from users. The Huber Mfg. Co., 345 E. Center St., Marion, Ohio.

Truck Cranes

182. Full-revolving, gasoline-operated Truck Cranes with a capacity of 7½ tons at a 10 ft. radius, for mounting on a 5-ton or 7½ ton auto-truck, are described in Bulletin 62, issued by the Orton Crane & Shovel Co., 608 S. Dearborn St., Chicago, Ill.

Truck Hoists

183. "Dump Truck Hoists." Double the Truck's Value by using power operated Hydraulic Hoists. Booklet published by WOOD Hydraulic Hoist and Body Company, 7924 Riopelle St., Detroit, Michigan, describes Hydraulic Hoists for every make and model of Truck.

Wheeled Scoops

190. The WARCO wheeled scoops, claimed to offer the most economical handling of earth on short hauls, is fully described and illustrated in Bulletin No. 3102 issued by the W. A. Riddell Co., of Bucyrus, Ohio. Printed in three colors and fully illustrated—will be sent to anyone interested.

Road and Street Maintenance

Asphalt Heaters

201. Tar and Asphalt Kettles, Oil Burning Kettles, Pouring Pots, Torches and Hand Spraying Attachments. Full data. Connery & Company, Inc., of Philadelphia.

202. Connery & Company, Inc., 3900 N. Second St., Philadelphia, Pa., has issued a new Bulletin "J" describing the latest and improved style "J" Oil Burning Kettle for Paving Contractors, Street and Highway Departments.

203. A 54-page booklet issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates oil, wood and coal burning asphalt and tar kettles, tool heaters, sand dryers, tool boxes, traffic line markers, grout mixers, asphalt tools, etc.

Dust Control

210. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with dust control, road building and maintenance. It contains tables and composition, grading, etc.

211. "Dust Control," a concise, handy pocket reference on control of dust by use of 3C Calcium Chloride. Illustrated. Issued by the Columbia Products Company, Barberton, Ohio.

Dust Laying

213. Solvay Sales Corporation, New York, supplies full information regarding the use of Solvay Calcium Chloride for effectively laying dust. The booklet, "Solvay Calcium Chloride, a Natural Dust Layer," 24 pages, 5½x8, covers application, economies, etc. Sent without cost.

Equipment

215. "Road and Street Maintenance Equipment," a compact vest pocket manual containing illustrations and brief descriptions of their extensive line, has just been issued by Littleford Bros., 452 East Pearl St., Cincinnati, Ohio.

216. "Light and Heavy Road Maintenance" is the title of a recent folder showing the tremendous power developed by the FWD truck and its economy for use in pulling road graders and maintainers—issued by the Four Wheel Drive Auto Company, Clintonville, Wisconsin.

Surface Heaters

218. The new "Hotstuf" three in one, combination Tool, Asphalt and Surface heater is fully described and illustrated in Bulletin 16 just issued by the Mohawk Asphalt Heater Co., 56 Weaver St., Schenectady, N. Y.

Road and Paving Materials

Asphalt Plank

220. The Philip Carey Company, Cincinnati, Ohio, has available a handsome booklet describing Elastite Asphalt Plank for Bridge Flooring—with specifications for use—liberally illustrated with photographs.

Concrete Curing

235. "How to Cure Concrete," is a manual of instruction on the curing of concrete pavements. A handy, useful volume, well illustrated. 47 pages, 5½x7½. The Dow Chemical Company, Midland, Mich.

Culverts, Corrugated

236. The added advantage in using Toncan Iron Culverts under highways for airport drainage, storm sewers, suburban allotments, etc., because of Toncan's alloy composition, is described in bulletin—"We are living in the Alloy age"—Toncan Culvert Mfrs. Association, Massillon, Ohio.

Culverts—Corrugated Metal

238. A new 24-page, well-illustrated catalog, listing the advantages that follow the use of Armco corrugated iron culverts and containing complete instructions for ordering and installation has been published by Armco Culvert Mfrs. Association, Middletown, Ohio. Write for Culvert Catalog No. 6.

Expansion Joint for Pavements

250. Premoulded Expansion Joints in several different types, including a new asphalt rubber joint, in order to meet various construction conditions are covered in literature issued by the Servicised Premoulded Products, Inc., 53 W. Jackson Blvd., Chicago, Ill.

251. Full information on the use of Expansion Joints in pavements, bridges, pools, walls and other concrete work, including best installation methods, may be obtained from The Philip Carey Company, Cincinnati, Ohio.

Jacking Method

260. No interruption to traffic, and substantial savings in construction costs are the main advantages secured by using the Armco jacking method to install conduits, drainage openings, and passageways under streets, highways and railroads. A new catalog, "The Armco Jacking Method," describing this modern means of construction and its many applications, will be sent upon request, by Armco Culvert Mfrs. Association, Middletown, Ohio. Ask for Catalog No. 7.

Maintenance Materials

267. "Mixed-in-Place Construction with Tarmac." Step-by-step pictures and specifications for constructing road surfaces by Retread or Turnover methods. American Tar Products Co., Koppers Bldg., Pittsburgh, Pa.

268. Road and street maintenance and reconstruction with BITUMULS Cold Asphaltic Binder described in an illustrated paper by C. H. Thomas, Maintenance Engineer. Reprints furnished by American Bitumuls Company, San Francisco or Baltimore.

270. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with road building, maintenance and dust control. It contains tables of composition, grading, etc.

272. "Asphalt for Every Purpose," a 44-page illustrated booklet describing Stanolind Asphalt products is now ready for distribution. Recently published by the Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

273. Complete directions for surface treatment and bituminous surfacing with Cut Back Asphalt are contained in a 36 page data book just issued by the Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

275. "Tarvia-K. P. for Cold Patching." An instructive booklet illustrating and describing each step in patching a road with 'Tarvia-K. P." 16 pages, illustrated, 3½x9. The Barrett Company, New York.

276. "Road Maintenance with Tarvia." A 56-page illustrated booklet of value to every road man. Shows how almost every type of road and pavement can be repaired and maintained with Tarvia. The Barrett Company, New York.

277. "Tarvia." An attractively illustrated 32-page booklet describing grades of Tarvia and showing photographs of actual application. The Barrett Company, 40 Rector St., New York City.

278. Information regarding crack and joint fillers furnished in gray, black, or other colors, for poured joints, also maintenance and repair work may be obtained by application to the Servicised Premoulded Products, Inc., 53 W. Jackson Blvd., Chicago, Ill.

Material Handling Buckets

280. The Owen Bucket Company, Cleveland, Ohio, have available illustrated folders on Material Handling Buckets, showing the various types, sizes and uses for which they are intended and construction features and other valuable bucket information. A complete catalog on all types of Material Handling Buckets will also be furnished on request.

Rail Filler

281. Bituminous Rail Filler used for sound deadening, rail insulation and pavement protection is described in pamphlet issued by Servicised Premoulded Products, Inc., 53 W. Jackson Blvd., Chicago, Ill.

282. Write to The Philip Carey Company, Cincinnati, Ohio, for complete and interesting data on the application of Elastite Rail Filler in Street Railway Tracks.

Sand and Gravel Buckets

290. The Owen Bucket Company, Cleveland, Ohio, have available illustrated folders on Sand and Gravel Buckets showing the various types, sizes and uses for which they are intended and construction features and other valuable bucket information. A complete catalog on all types of Sand and Gravel Buckets will also be furnished on request.

Garbage and Refuse Disposal

305. "Pittsburgh-Des Moines Incinerator," built and guaranteed by the Pittsburgh-Des Moines Steel Company, 3479 Neville Island, Pittsburgh, Pa., is described fully in a booklet sent on request.

Snow Removal

Snow Removal

348. "Winter Maintenance" is the title of a recent booklet issued by the Four Wheel Drive Auto Company, Clintonville, Wisconsin. Illustrates many types of snow plows and methods of handling snow removal problems.

349. "The Answer to the Snow Removal Problem" is the title of a new booklet just published by Carl Frink, Mfr., of Clayton, N. Y. It gives full details of the new Frink type S snow plow for trucks.

353. Efficient methods of combating quickly the snow menace on highways and city thoroughfares. Illustrates joint use of crawler tractors and standard and special snow plows. The Cleveland Tractor Co., 19322 Euclid Ave., Cleveland, Ohio.

354. "Snow Removal Equipment," a colorful booklet just off the press of the Caterpillar Tractor Co., of San Leandro, Calif., and Peoria, Ill. Various types of snow-fighting equipment built for "Caterpillar" Tractors are pictured in relief and in action.

355. "Conquering Snow With Caterpillars." "An Unwelcome Visitor Is Coming." "A Wall Ten Miles High." Three publications on the snow problem by the Caterpillar Tractor Co., Peoria, Ill.

358. The new Type "S" Frink Sno-Plows and Frink Leveling Wings, together with complete data for selecting the proper size snow plow for your particular make and model of truck. Published by Carl H. Frink, Clayton, N. Y.

359. Galion Iron Works and Mfg. Co., Galion, Ohio, will gladly furnish details, prices and catalogs of their snow plows adaptable to any make of truck.

Sewerage and Sewage Disposal

Activation and Aeration

390. A new booklet describing Norton Porous Mediums of bonded fused alumina (strong, chemically stable, uniformly permeable), the booklet will be of interest to all chemical and sanitary engineers. Issued by Norton Co., Worcester, Mass.

Inlets and Manhole Covers

400. Cast iron sewer blocks, ventilators, manhole covers and inlets, valves, etc., described in pamphlet by the South Bend Foundry Co., South Bend, Ind.

Jointing Materials

401. G-K Compound for vitrified clay sewers, MINERALEAD for bell and spigot water mains, also M-D Cut-Ins for making house connections, described in catalogue of Atlas Mineral Products Company, Mertztown, Pennsylvania.

402. An illustrated folder has just been issued by the Cochrane Chemical Co., 432 Danforth St., Jersey City, N. J., detailing the advantages and the savings in the use of Ex-XL-cell Sewer Pipe Joint Compound.

403. A recent publication of the Servicised Sales Company, Monadnock Block, Chicago, Illinois, tells of the superior tightness, flexibility and durability of fibrated asphalt Sewer Pipe Belts and Joint Compounds. Complete instructions and considerable data are included in the pamphlet, now available.

Sewer Joint Compound

404. Full details concerning No. 1 Korite for sealing sewer pipe joints so that they will be permanently tight are contained in an illustrated folder just issued by the Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

Pipe, Vitrified

405. Full information regarding Vitrified Pipe and other heavy clay products. Illustrated price list on application. Factories in Pennsylvania and Ohio. The Progressive Clay Co., offices in New York City, Philadelphia, Pa., and Syracuse, N. Y.

Pumps—Sewage

410. Non-clog vertical and horizontal sewage pumps are fully described and illustrated in new bulletins just issued by the Dayton-Dowd Co., Quincy, Ill.

Sewage Screens

414. The Dorr Co., 247 Park Ave., N. Y., publishes Bulletin No. 6391, which describes the construction and operation of the Dorrco Mechanically-Cleaned Bar Screen.

415. Link-Belt Company, Philadelphia, shows in Book 642 its line of sewage screens (Tark, Brunotte, and Straightline) for fine and coarse sewage; Straightline Collectors for Settling Tanks (Sludge, Scum and Grit; and Mechanical Aerators for activated sludge plants.

Sewer Cleaning Machines

416. Illustrated booklet describing Adjustable Turbine Sewer Cleaners, Self-Propelling Ferret Turbines, Drag Type Sewer Cleaners, Five Types of Sewer Rods, Conduit Rods, Windlasses, Sewer Braces, Sewer Cables. Turbine Sewer Machine Co., 5210 W. State St., Milwaukee, Wisc.

Sludge Bed Glass Covers

418. Sludge Bed Glass Covers—"Super-Frame" Hitchings & Co., Main Office, Elizabeth, New Jersey. Offer A. I. A. File 101SB, Describing glass covers for sludge and sprinkler beds.

Storm Sewers

424. A 24-page catalog, profusely illustrated with actual installations under widely varying conditions, which lists the features that give superiority to flexible corrugated metal construction for storm sewer installations, can be obtained from Armco Culvert Mfrs. Association, Middletown, Ohio. As for the catalog No. 5.

Treatment

425. Dorr Company, 247 Park Ave., New York, in its Sanitary Engineering bulletin describes the use of it's equipment for treating municipal sewage, industrial wastes and water. Photos of numerous operating plants are shown as well as representative flow sheets illustrating the various methods of sewage treatment.

427. The Pacific Flush Tank Company, of Chicago and New York, publish eight separate catalogs on Sewer and Sewage Disposal Automatic Equipment, including pumps, Imhoff Tanks and Sewer Joint Compounds. These are of real value to the designer or operator of a treatment plant.

428. Advantages of Liquid Chlorine for disinfection given in booklet issued by the Electro Bleaching Gas Co., 9 East 41st St., New York.

429. Chlorine is being extensively used in the disinfection of sewage not only as a disfectant but as an aid to other purification processes. Wallace & Tiernan Co., Inc., Newark, N. J., have a publication, No. 42, on the chlorination of sewage, which will be sent to any address on request.

430. The Dorr Co., 247 Park Ave., N. Y., publishes Bulletin No. 6171, which describes the treatment of sewage with Dorr Traction Clarifier, an improved type of continuous sedimentation for use in water and sewage treatment plants.

432. The Dorr Company, 247 Park Ave., N. Y. C., publishes Bulletin No. 6491, which describes the construction and operation of the Dorr Detritor for continuously removing and washing the grit from sewage flows.

434. Automatic, continuous vacuum filters, producing a relatively dry cake of sludge in demand for fertilizer, are used by: Milwaukee, Houston, Chicago, Gastonia, N. C., Charlotte, N. C., write for literature, Oliver United Filters, Inc., Federal Reserve Bank Bldg., San Francisco, Calif.

Water Works Equipment

Activation and Aeration

465. A new booklet describing Norton Porous Mediums of bonded fused alumina (strong, chemically stable, uniformly permeable), the booklet will be of interest to all chemical and sanitary engineers. Issued by Norton Co., Worcester, Mass.

Couplings and Tees

485. Copper pipe for water works services and patented connections for jointing to corporation stops, iron pipe, etc. Full data 22 pages 8½ x 11. The Mueller Co., Decatur, Ill.

505. "Mathews" Fire Hydrants. Gate Valves and other water works appurtenances. 16 pages, 7¾x10¾. R. D. Wood & Co., Philadelphia.

506. Hydrants, tapping apparatus, gate locks, valves and curb cocks described in a series of bulletins issued by A. P. Smith Mfg. Co., East Orange, N. J.

Jointing Materials

515. MINERALEAD for bell and spigot water mains, G-K Compound for vitrified clay sewers, also M-D Cut-Ins for making house connections, described in catalogue of Atlas Mineral Products Co., Mertztown, Pa.

Meter Boxes

526. An illustrated catalog covering meter boxes and specialties such as gate valve housing, curb boxes, meter testers, melting furnaces, jointing materials, four-in-one pumps, has recently been published by the Hydraulic Equipment Co., Reading, Pa.

Pipe, Cast Iron

534. "Sand-Spun," Centrifugal cast iron pipe manufactured by R. D. Wood & Co., Philadelphia, is fully described in a valuable 16-page 6x9 booklet, containing also complete specifications of this pipe. No engineer or water works official should be without this booklet.

535. Cast Iron Pipe and Fittings, sizes 1¼ through 12 inches, either with or without Precaulked lead joints factory-made in the bells. Data book sent free. The McWane Cast Iron Pipe Co., Birmingham, Ala, and Provo, Utah.

536. "Weights and dimensions of Cast Iron Pipe and Fittings." A handy reference book for Municipalities and Contractors. 48 pages, 7¾x10¾. R. D. Wood & Co., Philadelphia.

539 U. S. Cast Iron Pipe Handbook contains useful tables and data for the Water Works man on pipe line construction. Issued by U. S. Cast Iron Pipe and Foundry Company, Burlington, N. J.

Pipe, Cement Lined

540. Steel or Wrought Iron Pipe lined with cement and special lead-lined joints, manufactured by the Cement Lined Pipe Co., of Lynn, Mass.

Pipe for Subdrainage

549. The benefits following the use of Armco perforated iron pipe for various municipal uses such as golf course, athletic field, and airport drainage; and its various applications in the construction and maintenance of highways and railroads are outlined in the 24-page illustrated catalog entitled, "Armco Perforated Iron Pipe." Catalog No. 4 is obtainable upon request from Armco Culvert Mfrs. Association, Middletown, Ohio.

Pumps, Waterworks

560. Centrifugal pumps for high or low service pumping for waterworks and filtration plants. Bulletins contain interesting installation photos, characteristic curves, etc. Dayton-Dowd Co. Mfrs. Centrifugal Pumps, Quincy, Ill.

Pump Packing

575. "When Power Is Down," by the Sterling Engine Company, Buffalo, N. Y., gives recommendations of models for standby services for all power requirements.

Service Boxes

578. "Service Boxes with Stay-on Covers. No more broken covers. No more lost covers." (Booklet). The Central Foundry Company, 120 Lexington Avenue, New York, N. Y.

Swimming Pools

580. Wallace & Tiernan Co., Inc., Newark, N. J., have just published a new edition of technical publication, No. 41, dealing with the sterilization of swimming pools by liquid chlorine. Copy sent on request.

Tanks and Stand Pipes

582. A 50-page booklet issued by Pittsburgh-Des Moines Steel Co., 3479 Neville Island, Pittsburgh, Pa., on complete water works plants, elevated tanks, stand pipes and filtration plants built by them.

Tapping and Valve Machines

583. The A. P. Smith Company, of East Orange, N. J., furnish descriptive matter dealing with their many labor saving devices as the Smith tapping machine, valve inserting machine and pipe cutting machines.

Valves

585. Catalog covering our line of Bronze and Iron Valves for service on Steam, Water, Gas, Gasoline, Air and Oil lines furnished upon request. Also data on "Dart" Unions and Fittings. The Fairbanks Company, 393 Lafayette Street, New York, N. Y.

Miscellaneous

Airport Construction

595. Airports and Airways. A 20-page illustrated booklet by the Caterpillar Tractor Co., Peoria, Ill., describes the uses of tractors in building airports and handling planes.

597. "Getting on the Air Map With 'Caterpillar'," profusely illustrated with action pictures, describes the many uses of the tractor in building and maintaining airports better, quicker, cheaper. Caterpillar Traction Co., San Leandro, Calif., and Peoria, Ill.

Airport Drainage

599. The added advantage in using Toncan Iron Culverts under highways for airport drainage, storm sewers, suburban allotments, etc., because of Toncan's alloy composition, is described in bulletin—"We are living in the Alloy age"—Toncan Culvert Mfrs. Association, Massillon, Ohio.

Asphalt Bridge Planking

600. A new and improved asphalt composition has been developed as a long wearing and resilient paving material for bridges, viaducts, railroad platforms, etc., covered by Catalog No. 12, now available from Servicised Premoulded Products, Inc., 53 W. Jackson Blvd., Chicago, Ill.

601. The Philip Carey Company, Cincinnati, Ohio, has available a handsome booklet describing Elastite Asphalt Plank for Bridge Flooring—with specifications for use—liberally illustrated with photographs.

Late Developments in the Engineering Field

Ingersoll-Rand to Supply Compressors and Rock Drills for Hoover Dam

Six Companies, Inc., the contractors, who will build the Hoover Dam, have placed orders with Ingersoll-Rand Company for all air compressor and rock drilling equipment that will be required for this record breaking five-year project.

The stationary air plant will consist of a battery of large Class "PRE" type direct-connected, electric-driven compressors having a combined output of 25,000 cubic feet per minute.

These compressors will supply air for driving the four diversion tunnels that will carry the waters of the Colorado River through the canyon walls around the damsite while the dam proper is being built. Work will start immediately upon these tunnels and it is expected that they will be finished within 18 months.

These tunnels are interesting as constituting the largest rock tunnels ever to be driven for comparable distances. Each of them will be 57 feet in diameter, and a mile long. Four tubes almost the size of the Holland Vehicular Tunnels between New York and New Jersey could be placed in any one of them. A total of 1,563,000 cubic yards of rock will be excavated in driving them.

All told, approximately 5,800,000 cubic yards of rock will be excavated in connection with the undertaking. Preliminary estimates indicate that about 15,000 miles of drill holes will be required on this phase of the work.

It is expected that the work will be carried on from one heading only, as the time allowance is sufficient to permit this, thereby reducing the investment in plant that would be required if two or more headings were opened.

Because there is no space available in the river bottom, all the excavated material from the tunnels will have to be elevated up over the canyon walls for disposal.

Smaller Ingersoll-Rand compressors of the portable type will operate the rock drills that will be used to scale down the canyon walls on either side of the damsite to guard against rock slides.

First Ingersoll Rand Units at Hoover Dam

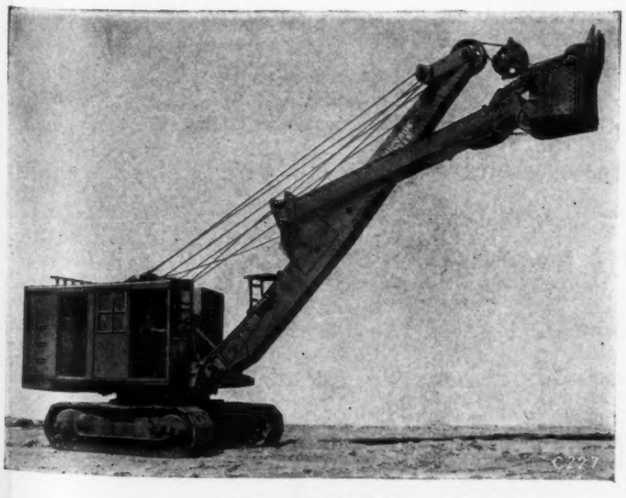
A New Dirt Handler

Bucyrus-Erie recently announced the 43-B, a new 1½-1¾ yard shovel-dragline-crane-clamshell built for increased yardage production at lower unit costs. The manufacturer offers the choice of Diesel, gasoline, or electric power, rope or chain crowd on the shovel, regular or special extra long and wide mountings for soft ground dragline work. Simplest possible convertibility saves time and money in changing over for other types of work.

Write the manufacturer at South Milwaukee, Wisconsin, mentioning this magazine, for full information regarding this new member of the Bucyrus-Erie complete line.

Fill This Road Roller With Concrete

The Ann Arbor Machine Co., Shelbyville, Ill., has brought out a new type of road roller for maintenance work. It is a shell of such dimensions that, when filled with concrete by the purchaser, it becomes a tractor-drawn road roller of 4, 6 or 10 tons. The weight unfilled varies from 1700 pounds for the 4-ton roller to 3350 pounds for the 10-ton with brake. The manufacturers claim economy in first cost and a wide range of use.



Bucyrus-Erie 43-B

Ann Arbor Road Roller

Chains and Speed Reducers

607. Link-Belt Co., Indianapolis, Ind., gives full description of its positive drives in books. No. 125 Silent Chain; No. 1257, Roller Chain; No. 815, Herringbone Speed Reducers; No. 1050, Promal Chains. Send for these positive power transmission books.

Community Advertising

610. Booklet showing various forms of publicity matter useful in arousing interest in the construction of small town water supplies. This matter is furnished free to Consulting Engineers and towns interested in waterworks construction by The Cast Iron Pipe Research Association, 566 Peoples Gas Bldg., Chicago, Ill.

Flexible Joints

611. Bulletin 204 containing 60 illustrations gives complete data regarding uses and specifications of Barco flexible joints for water works, sewage disposal plants, road contractors pipe lines, etc. Just issued by the Barco Mfg. Co., 1800 Winnemac Ave., Chicago, Ill.

Highway Crossings

612. A most serviceable and durable railroad crossing for city streets and main highways, is composed of fibrated asphalt planking and rail filler sections. Complete description and data will be furnished by Servicised Premoulded Products, Inc., 53 W. Jackson Blvd., Chicago, Ill.

Miscellaneous

618. Pipe Lines and the Caterpillar. In this 32-page booklet are pictured many uses of the Caterpillar Tractor, and ways in which they can be applied to the saving of men, money and minutes. The Caterpillar Tractor Co., Peoria, Ill.

Municipal Drainage Products

620. A complete line of drainage products which meets the modern municipal need for drainage materials that are quickly installed, safe, and dependable and economical in service is described in the new 24-page, illustrated catalog, "Armco Municipal Drainage Products." A request to Armco Culvert Mfrs. Association, Middletown, Ohio, for Catalog No. 9 will bring you this book free of obligation.

Rules

625. The Lufkin Rule Company, Saginaw, Mich.; New York; Windsor, Canada. Manufacturers of Measuring Tapes, Boxwood Rules, Spring Joint Rules, Straight and Folding Steel Rules, Fine Mechanics Tools and Aluminum Folding Rules. General Catalog No. 11.

Tree Moving

632. "Tree Moving," folder from the Caterpillar Tractor Co., of San Leandro, Calif., and Peoria, Ill., shows and tells with action pictures and the letters of landscaping experts how to successfully move large trees.

New Catalogs

Not described before in this Industrial Literature Section

Brick, Paving

230. Full information and data regarding the use of vitrified brick as a paving material may be obtained from the National Paving Brick Manufacturers' Association, National Press Building, Washington, D. C.

Sewage Pumps

411. Full information regarding sewage pumps is given in publication 210, and a large number of sewage pump installations are illustrated and described in publication 193. The American Well Works, Aurora, Ill.

Pumps

561. Double suction centrifugal pumps are described in Bulletin 197; multi-stage centrifugals in Bulletin 200; deep well turbines in Bulletin 211, and a number of municipal pump installations in Bulletin 178. These contain much valuable data. Free on request. The American Well Works, Aurora, Ill.

Index to Advertisements

When you want catalogs describing materials or equipment advertised in PUBLIC WORKS, refer to the classified INDUSTRIAL LITERATURE section beginning on page 93 and order by number.

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